THE UNIVERSITY OF ALBERTA

TEACHER-LEARNER INTERACTION, INFORMATION PROCESSING STYLES, AND STUDENT DECISION-MAKING

By

© HAL CHALMERS

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE
DOCTOR OF PHILOSOPHY

DEPARTMENT OF ELEMENTARY EDUCATION

EDMONTON, ALBERTA
SPRING, 1972

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Teacher-Learner Interaction, Information Processing Styles, and Student Decision-Making" submitted by Hal Chalmers in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

ABSTRACT

A common practice in schools has been to differentiate students on the basis of intelligence scores and achievement scores. Teachers who attempt to provide for these differences may choose to alter the instructional setting in order to meet the perceived needs of particular students. Thus the interaction which occurs between a particular teacher and a particular type of student has become an area of study for educational researchers. In addition, new sources of individual differences have been discovered such as the area of information processing styles.

The present study is concerned with the interactive effects of teacher and student information processing styles (reflection-impulsivity and differentiation) on student decision-making performance.

Eight teachers, employed by the Edmonton Separate School Board, participated in the study. Teachers were selected on the basis of their reflection-impulsivity and differentiation scores. Students, in the classes of these teachers, formed the sample (N=125).

Students were categorized on the basis of their reflection-impulsivity and differentiation scores. Following this, a unit in Social Studies was taught by all teachers. The criterion measure was a decision-making test administered after completion of the unit.

Correlations were run between all variables. Significant correlations were found between student decision-making scores and student and teacher differentiation scores as well as student intelligence test scores. Student reflection-impulsivity was found to be significantly correlated with sex of students.

Analysis of variance revealed a significant difference in student decision-making performance due to differentiation scores of students. In addition an interaction effect among both teacher information processing styles and both student information processing styles was found. Analysis of this interaction indicated that student decision making performance was best when both students and teachers had high differentiation scores but different reflection-impulsivity scores. The lowest performance resulted when both students and teachers had low differentiation scores.

The present study was exploratory. However, some implications for student placement, teacher selection, team teaching, and theories of information processing have been suggested.

ACKNOWLEDGEMENTS

The completion of this thesis could not have been achieved without the liberal assistance and support provided by many. The teachers and students who gave their time and supplied the data for the study. Mr. D. Precht of the Computing Services Division who provided much support and guidance during the analysis stage. Acknowledgement must also be made to Mr. N. McBurney and Science Research Associates who provided many of the materials needed for the study.

Members of the thesis committee Dr. J. Biggs and Dr. C. Chamberlain offered assistance and guidance at each stage of the study. In addition, special thanks to Dr. M. Horowitz for the encouragement and guidance provided. Throughout the whole of the study the Chairman, Dr. N. Hersom, gave unsparingly of her time and provided much appreciated guidance and support.

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CHAPTER I

THE PROBLEM

Introduction

Recognition by teachers of the existence of individual differences among children may lead them to make judgements about a child's behaviour and about how he might respond better if the instructional setting or instructional strategies were altered in someway. By making such changes, teachers attempt to meet the perceived needs of a particular child. Differences among learners have been attributed in the past to such sources as general ability, motivation, interest, values, as well as ethnic, socio-economic and experential background. Many practices in education have been developed to compensate for differences in any of these factors in order to overcome the learning difficulties encountered by various pupils.

In the last decade, additional sources of variation among individuals have been researched. One such area of investigation has been concerned with the cognitive process or how individuals process information differently. These differences in cognition have been labelled cognitive styles, or information processing styles. These styles do not fit into the

conventional categories of mental ability and, therefore, have opened up a new area of exploration for educational researchers. In other words, information processing styles are thought of as those ways of thinking in which individuals vary but which are not related to general ability identified by standardized intelligence tests.

Until recently educational research has tended to emphasize the identification of various sources of individual differences. However, the important point, as Biggs (1972) points out, is that teachers, in addition to knowing something about the instructionally relevant ways in which children differ, should also know what to do about it. Hunt (1971) also recognizes this need and states that one of the greatest obstacles facing educators is the lack of knowledge on how to place a student in an educational environment that is best suited for that particular student.

The possibility that the educational environment may affect learners differently has received little attention by educators. By focussing on the student alone, or on the environment alone, without consideration of the possible effects of interactions between the student and the educational environment, researchers may have missed important sources of variation. Cronbach (1967) supports this view by stating that general ability

is not a good variable to differentiate students on since ability is related to performance, whatever the educational environment. He advises that more fruitful results from studies on individual differences will likely occur when simple aptitudes that do not correlate highly with performance are used. Cronbach goes on to say that if different instructional environments capitalize on different individual aptitudes, then research, carried out on groups of students matched by aptitude and treatment, might show different results from those obtained in studies that compare treatments only. This type of research is illustrated by Cronbach's use of the Aptitude Treatment Interaction Approach. The theory underlying this approach is that one treatment may be effective with children who are high on a particular aptitude but the same treatment may be less effective with children who are low on that aptitude. However, with another treatment the effect could be reversed.

Several aptitudes which appear to be instructionally relevant but are not closely related to general ability have been identified by researchers in the past fifteen years. The original theoretical construct of aptitudes or styles of perceiving and processing information was alluded to by Kelly (1955) who stated

that man views the world through "transparent templets" and that these patterns are used to filter and sort out incoming information. Since 1955 many theorists have expanded the concept of aptitudes and researched several dimensions upon which individuals are believed to differ.

Kelly (1955) originally suggested that the ability to assess stimuli by using many rather than few bases to generate a number of alternative courses of action, might be an aptitude which would affect the characteristic way in which a person handles and relates information. The aptitude referred to by Kelly has been called differentiation. Since 1955 theorists have developed theories based on the construct of differentiation to attempt to explain differences in the ways individuals handle information.

Harvey, Hunt and Schroder (1961) developed a "Conceptual Systems Theory" which proposes that there are various levels of conceptual systems functioning. The primary emphasis in this theory is on individual differences in concreteness or abstractness. An individual's perception and interpretation of incoming information is related to the stage of concreteness or abstractness at which he is operating. The more concrete individual tends to categorize information on a small

number of dimensions. In other words, he does not differentiate to a great extent. The more abstract individual tends to relate incoming information to a larger number of dimensions and, therefore, has a greater ability to differentiate.

Schroder, Driver and Streufert (1967) postulated that individuals differ in the level of integrative complexity at which they function. Integration involves interrelating a number of dimensions to form new or higher order combinations of dimensions. While integration is not directly dependent on the ability to differentiate, it appears to be related. The person functioning at a low level of integrative complexity tends to be more concrete and to focus on a small number of dimensions. While it is possible that he is differentiating several dimensions, he does not use all of them. However, it appears more likely that he does not differentiate a very large number of dimensions. Alternatively, the person who has a high integrative index is more abstract and differentiates on the basis of many dimensions and then integrates these to form new categories.

Another aptitude, which appears to be related to Kelly's (1955) original construct, is that of reflection-impulsivity (Kagan, Rosman, Day, Albert and Phillips

1964). This aptitude has received considerable attention and has been relatively well researched. Kagan and his associates have identified certain individuals who tend to be reflective and others who tend to be impulsive. The reflective person may be thought of as one who is able to differentiate a large number of dimensions and then integrate these in order to reach a solution. The impulsive person is thought to be one who may or may not differentiate many dimensions, but who does not integrate in order to reach a solution. It appears that reflection involves both differentiation and integration. Biggs (1972) in his model of information processing has proposed that differentiation occurs at an earlier stage than the process of fine-coarse matching which is essentially the same as reflection-impulsivity. Differentiation is considered to involve the filtering or sorting out of incoming information on various dimensions. Fine-coarse matching, on the other hand, is a higher order cognitive process which involves comparison of the information that has been sorted out, through the process of differentiation, to information that has been stored previously in the individuals Long Term Store. In this model the incoming information passes through several stages of processing. Biggs suggests that there may be a number of aptitudes in operation at each stage of processing.

Statement of the Problem

Both teachers and students vary on aptitudinal or style continuums such as differentiation and reflection-impulsivity. It has been shown that student performance, on some tasks, is related to the style of information processing of the individual. It has been hypothesized that teachers, who have certain styles of processing information, provide a distinctive learning environment for their pupils. This distinctive learning environment may have an effect on student achievement. If this is the case, then it is important for those making placement decisions to know which type of teacher to place with certain types of students.

The present study has been designed to consider how the interaction of student and teacher aptitudes affects student performance on a decision-making task.

Significance of the Study

Educators in general, and curriculum developers in particular, need more information about those styles of information processing which affect student performance. In addition, teachers should be aware of the effect of their own aptitude on the performance of individual students.

If research indicates that student performance is affected by particular teacher aptitudes, then it may be possible to group students with teachers who have certain aptitudes and this might provide the student with the opportunity to achieve at the highest level possible for him. Research which indicates whether it is preferable to match students and teachers who have similar or possibly dissimilar ways of processing information, has important implications for curriculum. Although different theoretical models for the grouping of children and placement of these groups have been proposed by Hunt (1971), Mogar (1969) and Snow (1969), little research has been conducted to test these models in order to identify ways of matching students and environments which might enhance student performance.

A curriculum, to be effective, should provide for differences among students and also among the various environments in which the students are situated. For example, without consideration of these variables, a particular curriculum may be effective for a certain type of student in a certain environment but completely ineffective for another type of student in the same environment. This situation is not consistent with the aim of education which seeks the development of each

individual to his full potential. Curriculum planning may be limited and incomplete without consideration of aptitudinal differences among students and teachers.

Thesis Organization

Chapter II considers the theoretical basis for those studies reported in the research literature, which have explored the effect of cognitive or information processing styles on various learning tasks. Chapter III outlines the development of the testing instruments which were essential to the study. These were based on the selected theory and research studies delineated in Chapter II. In addition, Chapter III outlines the sampling procedure utilized in this study.

The findings have been reported and discussed in Chapter IV. Finally a summary of the study with a discussion of implications is presented in Chapter V along with suggestions for further research.

CHAPTER II

BASES FOR THE STUDY

Theoretical Framework

Compared to that of lower animals, human "thought" is characterized by the generation of a greater number of alternative ways of responding to a given stimulus. A human engaging in complex thought processes can perceive stimuli in many ways, and can consider several ways of interrelating these perceptions for his adaptive purposes. In this sense, human thought has more degrees of freedom. More meanings can be attributed to objects and a greater number of connections among these meanings arise. In this way, human thought is less stimulus bound; action can be delayed; and a given stimulus gives rise to a larger number of outcomes, which may create more uncertainty and ambiguity (Schroder et al., 1967).

However, among human beings there appear to be consistent individual differences in the ways individuals perceive and differentiate among stimuli as well as differences in the ways these perceptions are interrelated or integrated by individuals. Such differences are evident in the area of information processing styles or aptitudes. For example, individuals tend to differentiate and integrate stimuli by use of characteristic

pre-set plans which they apply in a relatively consistent manner.

The nature and importance of these styles were alluded to by Kelly (1955) a decade and a half ago:

> Man looks at his world through transparent patterns or templets which he creates and then attempts to fit over the realities of which the world is composed. The fit is not always very good. Yet without such patterns the world appears to be such an undifferentiated homogeneity that man is unable to make any sense out of it (pp. 8-9)

Kelly's statement appears to have relevance to the present study since information processing styles may be conceived as transparent patterns through which incoming information is filtered and related to the individual's cognitive structure.

On the basis of Kelly's theory, Bieri (1955) developed the concept of cognitive complexity. Bieri postulated that cognitive complexity was an aptitude in the processing of information that would allow us to predict how certain individuals transform stimuli into different kinds of judgements. Bieri (1966) defined cognitive complexity as:

> ... a tendency to construe social behaviour in a multidimensional way, such that a more cognitively complex individual has available a more versatile system for perceiving the behaviour of others than does a less cognitively complex person (p. 14).

In Bieri's view, cognitive complexity is the result of either a great number of dimensions, or a great number of differentiations upon dimensions, along which the social environment may be perceived.

Differentiation

The concept of differentiation, or the ability to perceive the social environment along many dimensions, became the basis for several theories of information processing. Although these theories emphasize higher order processing such as conceptual and integrative complexity, their basis is the ability to differentiate. Therefore, they appear to have some relevance to the present study.

Harvey, Hunt and Schroder (1961) have developed a conceptual systems theory which emphasizes the concreteness or abstractness of the individual's information processing. Differentiation, however, plays an important part in determining the individual's level of conceptual complexity.

According to Harvey and his associates (1961), an individual may move from one level of conceptual complexity to another. Four systems of conceptual complexity which represent stages of concreteness or abstractness are described. In brief, the individual

in the lowest system functions in a concrete manner, interprets the environment in terms of absolutes and views information in a black-white categorical manner. The individual at the highest stage functions at a high level of abstraction and has a highly developed ability to differentiate. This individual is oriented toward problem solving and information seeking.

Schroder, Driver and Streufert (1967) have based their work on that of Harvey and his associates (1961), but stress the manner in which the individual uses the information he receives in terms of how the information is combined and related. This combining and relating of information has been termed "integrative complexity". Individuals are viewed as functioning at different levels of integrative complexity. The level of integrative complexity at which a person is functioning is related to the number of dimensions of information which he is able to differentiate, as well as the manner in which he integrates these dimensions.

Schroder, Driver and Streufert (1967), state that the ability to differentiate on a larger number of dimensions does not necessarily result in greater integrative complexity. However, the likelihood of high level integration is increased with greater differentiation.

Reflection-Impulsivity

Kagan and his associates (Kagan, Moss and Sigel, 1963; Kagan, Rosman, Day, Albert & Phillips, 1964; Kagan, Pearson and Welch, 1966) have been concerned for some time that the construct of differentiation on a large number of dimensions has been over-stressed. They state that while the construct of differentiation may help us understand gross differences among children, it does not adequately explain the large qualitative differences in cognitive performance that exist among children and adults (Kagan, Moss and Sigel, 1963).

Kagan and his associates (Kagan, Rosman, Day, Albert and Phillips 1964), contend that there has been a tendency to de-emphasize the importance of differences in the ways individuals process information. These differences occur both in the aspects of stimuli that are initially selected for labelling (differentiation) and the degree of reflection that is attendant upon the classification of information and the selection of a solution (reflection).

Therefore, Kagan and his colleagues (1964) began research on a construct which they labelled reflection-impulsivity. This construct was supported by a number of investigations which showed that individuals have a consistent tendency toward fast or slow decision times.

The reflective individual was defined as one who waits for a long period of time before making a decision. This decision is usually correct. Alternatively, the impulsive individual tended to make quick decisions which were usually incorrect.

Information Processing Theories

The theories of information processing outlined by Harvey, Hunt and Schroder (1961) and Schroder, Driver and Streufert (1967) suggest that information processing occurs in stages. The first stage involves the initial differentiation of incoming information on a number of dimensions. Following this, integration occurs. Kagan and his associates (1964) postulate that selection of alternatives is the stage which follows integration.

A stage theory of information processing, which incorporates and builds upon the preceding theories, has been developed by Biggs (1968). This theory of information processing identifies several stages at which information is thought to be processed by the individual (Figure 1). Biggs (1972) postulates that there are several aptitudes or information processing styles, upon which individuals may show individual differences, at each stage in his model. He suggests that differentiation occurs in the Plan Stage and that reflectivity

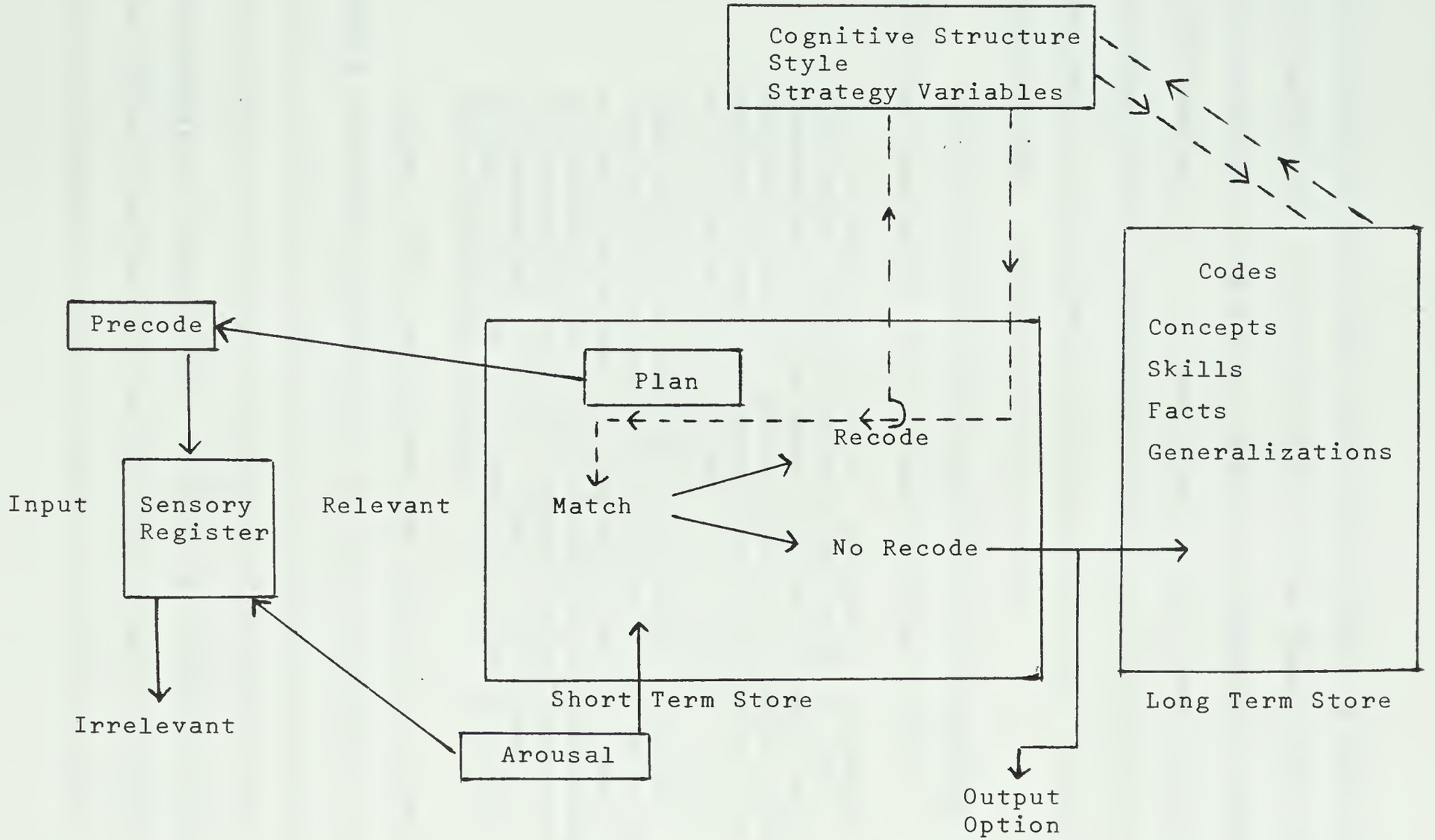


FIGURE I

INFORMATION PROCESSING MODEL

Adapted from Biggs (1970)

takes place in the Short Term Store Stage. Biggs (1972) postulates that as the capacity of the Short Term Store increases, the individual is able to handle more dimensions (differentiation). As more dimensions become salient, so they may become organized and structured (integration) to form various alternatives which may then be compared in order to make a selection (reflection).

One of the problems associated with research on cognitive complexity is outlined by Biggs (1972):

> ... substantial lines of complexity research have been carried out that are more or less independent of the developmental (Piagetian) approach itself. These other approaches differ amongst themselves according to the extent to which the authors stress articulation, differentiation or integration. All of this work goes under the heading of research into the variable of cognitive complexity, and it demands a singular degree of complexity on the part of the reader to make the necessary articulations, differentiations and integrations presupposed to understand it all. This is unfortunate because much of this work does have potential for educators [p. 7-20].

Biggs (1972) emphasizes the important of considering individual differences in the processing of information. Although other styles or aptitudes have been identified, the one which appears to be basic in the processing of information, is that of differentiation. The style of reflection-impulsivity appears (holding context constant) to be dependent on differentiation, but

involves the higher order cognitive processes of integration and selection among alternatives. Therefore, one possible approach for exploratory research in information processing might be to consider the relationship between these two styles (differentiation and reflection) and to attempt to determine ways these styles affect student achievement.

An appropriate measure of student achievement would appear to be a decision-making task since both differentiation and reflection are thought to contribute to the decision-making process. Decision-making, according to Sieber and Lanzetta (1964) typically requires that one make a selection among alternatives without having sufficient information to make an unequivocal choice. In the face of such uncertainty, the individual is likely to attempt to acquire further details (differentiate on a larger number of dimensions) to reorganize the information (integrate further) and to take longer to reach a solution (reflection).

On the basis of the preceding theories, one might expect a relationship to exist between student achievement on a decision-making task, and the student's ability to differentiate as well as his tendency to be reflective or impulsive.

Matching Models

Three models which are concerned with the grouping of students and teachers in order to allow for the best chance of student success, have been proposed by Mogar (1969), Snow (1969), Hunt (1971). These models are concerned with distinquishing the best person-environment combinations.

Matching. The term "matching" does not necesarily mean grouping of students with teachers who have information processing styles that are the same of those of their students. Matching may mean grouping students of like characteristics with a teacher whose characteristic information processing style is different, if this results in better student performance (Hunt, 1971).

Environment. Each of the three models which are discussed below is concerned with the interaction of the learner and his environment. In the classoom setting a major determiner of the environment may be assumed to be the teacher. In this study the information processing style of the teacher has been selected as the variable that is most important in determining the type of environment that is created. Mogar (1969) has distinquished three environment-learner models. These are: 1) the uniformity model which assumes that

all children learn alike and, therefore, no consideration is given to placement of different types of students with different teachers; 2) the congruence model which suggests that students with particular information processing styles be grouped with teachers who have the same style of processing information; 3) the compensatory model which proposes that students with a certain style of information processing be grouped with teachers who have the opposite style of information processing.

Mogar (1969) postulates that the congruence model is likely to restrict the development of the child's information processing style. In other words, if a child who scores low in cognitive complexity, is matched with a teacher who is also low in cognitive complexity, then the child is not likely to develop a high level of cognitive complexity, but is likely to remain at a low level. With reference to the compensatory model, Mogar (1969) suggests that if students and teachers who have different levels of cognitive complexity are matched, the result is likely to be a student who is greatly enriched since he is able to cope with a mode of functioning that is different from his own.

Snow (1969) has proposed two matching models which he calls compensatory and preferential. The compensatory

model suggests that an environment should be of such a nature that it compensates for a particular deficiency in the learner. In other words, the environment may function as an artificial aptitude for a learner who is deficient in that aptitude (Snow, 1969). In the preferential model, the optimal environment is one that supports the existing strengths and preferences of each learner (Snow, 1969).

If the compensatory model is valid, then students who are high on an aptitude would do well under all treatments and students who are low on an aptitude would do well only if the environment compensated for the student's weakness in a particular aptitude. Alternatively, with the preferential model, the students who are high on an aptitude might do poorly if the environment was such that it interfered with their preferred ways of processing information. The learner might resent this environmental interference and his performance might deteriorate.

Snow's (1969) compensatory model only allows for the prediction of ordinal interactions between the learner and his environment. The preferential model permits the prediction of disordinal or crossover interactions.

Hunt (1971) states that teachers should consider the effects that different instructional environments may have on different types of students. Hunt's (1971) matching model is an attempt to set forth "... those approaches most likely to facilitate achieving certain objectives for different kinds of persons [p. 34]. Hunt (1971) indicates that the first requisite of a matching model is to set up long-term goals for cognitive development. On the basis of this, one identifies the various stages which a learner must go through in order to reach the specified goal. The learning environment must be matched in the sense that the learner at Stage I of development (low cognitive complexity) should be matched with an environment that encourages Stage I type behaviour. Once Stage I has been accomplished and the individual moves on to a transition from Stage I to Stage II the environment must also change to allow for this transition. If the environment provided during the transition period is entirely at Stage II (medium-low cognitive complexity level) it would be super-optimal for the learner. If the environment is entirely at a Stage I level (low cognitive complexity) it would be sub-optimal for the learner. In either case the learner might remain at a Stage I level of cognitive complexity. Accordingly, knowledge of the

present cognitive level of the individual is essential in order to determine which environment is most likely to produce the desired effect (Hunt 1971).

Hunt (1971) proposes that if students are grouped according to conceptual structure, the teacher may then provide the environmental conditions most likely to promote progression through the four stages of cognitive complexity.

Curriculum and Instruction

Mauritz Johnson (1969) has stated that the curriculum consists of a set of intended learning outcomes. Instruction, according to Johnson, is the means that is used to implement the curriculum in order to achieve the intended learning outcomes. A curriculum should assume individualization of instruction and if this is compromised through group instruction then it must be accounted for in the instructional plan. In other words, it is in the instructional phase that the abilities, aptitudes and backgrounds of both teachers and students must be considered if the intended learning outcomes are to be achieved. Johnson thus implies that the instructional plan is a major determinant of the success of the curriculum. Since the instructional plan is greatly affected by the abilities, aptitudes

and backgrounds of both teachers and students then these factors are important in determining curriculum success.

Saylor and Alexander (1966) have listed some of the determinants which influence curriculum planners:

> ... pupils; social values, structures and demands; functions and aims of the schools; nature of knowledge; the process of learning [p. 7].

The process of learning is one of the determinants which has an important relationship to issues in curriculum planning.

This study is an attempt to explore one aspect of the learning process, namely the effect of interaction between teacher and student information processing styles. Such knowledge about the learning process provides guidelines for curriculum developers when selecting curriculum content, instructional materials, plans for curriculum organization, and for prescribing teacher-learner combinations which provide the best chance for the success of a curriculum when it is implemented.

RELATED RESEARCH

Investigation of information processing styles and matching models is relatively new in educational research. Therefore, only a limited number of studies

have been conducted to date. Of these, the studies on reflection-impulsivity, conceptual level, integrative complexity and Hunt's matching model appear to be most relevant to the present study.

The studies by Kagan and his associates bear directly on the reflection-impulsivity dimension. Studies of conceptual level are concerned with the concrete-abstract dimension and although this may be considered an information processing style, their relevance is primarily in the area of student-teacher interaction. The integrative complexity studies are related to the constructs of differentiation and reflection. Finally, the studies based on Hunt's (1970) matching model are directly relevant to the area of student-teacher interaction in terms of information processing styles.

Initially, those studies that demonstrate the influence of reflection-impulsivity on performance of learning tasks will be discussed. Secondly, a study that indicates the relationship between the home environment and the development of certain styles of information processing is reviewed. The next series of studies deal with the relationship of other variables such as personality factors, intelligence quotient and grade

point average to reflection-impulsivity and conceptual level. The final part is concerned with studies which have investigated the interaction between student dispositions (in terms of integrative complexity, conceptual level and reflection-impulsivity) and variations in the environment such as structure of presentation or the disposition of the teacher.

Relationship of task performance to reflection impulsivity. The studies in this area indicate that the habitual tendency of a student to respond quickly or slowly will affect his performance on a variety of tasks. These tasks will include learning to read, series-learning and inductive reasoning.

Kagan (1965), in a study of six year olds, hypothesized that children learning to read are confronted with a discrimination problem that has high response uncertainty and therefore reflective children would be less likely to commit word recognition errors than impulsive children. The object of this study was to determine if measures of reflection-impulsivity gathered in grade one, would be prognostic of reading performance one year later.

The sample consisted of 65 boys and 65 girls in grade one. Children were administered the Matching

Familiar Figures Test (MFF) and the Wechsler Intelligence Scales for Children (WISC), in addition to other tests. Results indicated that reflective children were significantly more accurate in word recognition than impulsive children. These results suggest that the child's tendency to make fast decisions in problems with response uncertainty is one determinant of quality of reading performance.

Kagan (1966) conducted another study dealing with the relationship of reflection-impulsivity to accuracy of performance in a series learning task (measured by number of errors of commission or words reported in a list that were never there). The sample consisted of 118 boys and 85 girls from grade three. Subjects were administered the MFF test and the WISC vocabulary and information scales. Kagan hypothesized that impulsive children would make more errors of commission in this serial learning task. This hypothesis was supported.

Kagan, Pearson and Welch (1966a) studied the performance of reflective and impulsive students on inductive reasoning problems. It was hypothesized that impulsive children would make more errors than reflective children since they would be prone to select an answer that was not carefully evaluated.

The sample in this study consisted of 79 boys and 76 girls in grade one. The test batteries consisted of the MFF test, assessment of performance on inductive reasoning problems, and the information and vocabulary scales from the WISC.

Results showed the usually negative correlation between response time and errors on the MFF, with greater consistency for girls than boys. Errors on the MFF were negatively correlated with the WISC verbal scale scores but response time was independent of verbal ability. Students who were reflective made fewer errors on the inductive reasoning tests, even when verbal ability was statistically controlled for.

In summary, the findings of the preceding studies suggest that the habitual tendency of a person to respond quickly or slowly has an effect on performance in three different types of learning tasks (discrimination, series learning, and inductive reasoning). These studies indicate that reflection-impulsivity might be an important dimension to assess when considering performance on learning tasks. As a result of these findings it was decided to make reflection-impulsivity an integral part of the present study.

Relationship of environment to reflection-impulsivity. In this area a study is reviewed which suggests that the home environment may be a determinant of the tendency of the child to respond quickly or slowly. The importance of the study is that it suggests the possibility of environmental factors determining an individuals style of information processing rather than the style being an innate characteristic. If this is the case, then possibly the school environment also plays an important role in the formation or modification of information processing styles.

Hess and Shipman (1966) conducted a study to determine the influence of teaching styles of mothers on learning styles and information processing strategies of children. They hypothesized that the growth of cognitive processes is fostered in family control systems which offer and permit a wide range of alternatives of action and thought, and that growth is restricted by systems of control which offer predetermined solutions and few alternatives for consideration and choice. In other words, the family situation which provides few alternatives precludes a tendency for the child to reflect and thus develops modes for dealing with stimuli which are impulsive.

The sample in the Hess and Shipman study consisted

of 160 Negro mothers and their four year old children. Results indicated that deprivation in terms of cognitive environment (where behaviour was controlled by status rules rather than attention to individual characteristics of a specific situation and was not mediated by verbal cues or by teaching that related one event to another) produced a child who was not reflective in behaviour and for whom consequences of an act were considered in terms of immediate reward or punishment.

Correlates of information processing styles. The studies reported under this heading are concerned with the relationship of personality variables, age, grade point average, achievement, intelligence, socio-economic status plus other variables, to reflection-impulsivity and conceptual level of the student.

Gupta (1970) has conducted an extensive study on the relationship between reflection-impulsivity (operationally defined by the Matching Familiar Figures Test) and several other cognitive and personality variables. The cognitive variables that Gupta considered were: mental speed, verbal ability, school achievement, integrative complexity, and analytic tendency. The personality variables considered were: extraversion, risk taking, locus of control, agreeing response set,

impulsiveness, anxiety, neuroticism and persistence.

Gupta's sample consisted of 217 grade ten students from academic and non-academic programs. All students were administered tests on all personality and cognitive variables in addition to the MFF test. On the basis of MFF latency and MFF error scores two groups of subjects (reflective and impulsive) were identified. For the purpose of factor analysis the subjects were divided into two random groups. The intercorrelations of all 17 variables for each of the groups were factor analyzed and the factor matrices were rotated according to different criteria.

The results of Gupta's study showed no relationship between MFF scores and personality variables. In the cognitive area, the reflective students had higher verbal ability, demonstrated greater persistence and showed better achievement in certain school subjects. Achievement in reading, language, mathematics and science plus total achievement correlated with MFF scores of reflection. However, this was not the case with literature and social studies. Integrative complexity was found to be independent of reflection-impulsivity.

Hunt (1970) found that the conceptual level of the student (measured by the Paragraph Completion Test) had a very low order relationship to intelligence (r=.20). There was also a low correlation between chronological age and conceptual level but (in another study) an orderly pattern

of increase (in conceptual level) was noted from ages 12 to 16 (Hunt 1968). In addition, Hunt (1970) found middle class superiority in conceptual level but greater variability in this level among lower class subjects. Female superiority was noted in both middle and lower class groups.

Pohl and Pervin (1968) studied the relationship between conceptual level and grade point average for different groups of students. They found that correlation between these two variables, for 28 engineering students was -.56 ($p < .01$) while the relationship for 22 social science students was .44 ($p < .05$) and for 60 humanities students .38 ($p < .05$).

Tuckman (1964) conducted a study to investigate information processing as a function of conceptual level as described by Harvey, Hunt and Schroder (1961). The subjects in this study were 64 graduate students who were given the Sentence Completion Test. In addition, several secondary scales were used to discriminate between concrete and abstract individuals. Of the original subjects, 36 were selected who clearly fell into the four types postulated by Harvey and his associates (1961). The 9 subjects in each group were further subdivided into three groups of three. Subjects were involved in a simulation game for 15 hours (over several days) and were rated by observers on abstractness of decision-making mechanisms, conflict, cooperation, motivation, and leadership. Group performance on objective task related dimensions, were measured by amount of information seeking, activity, sensitivity and other measures.

Results indicated that abstractness of group structures and of decision mechanisms varied directly with abstractness of group members. Concrete groups adopted a rigid hierarchical structure and used power differences in making decisions. The most abstract group, on the other hand, developed a "single-organism" type of structure and made decisions as a group. It was predicted that abstractness would result in increased flexibility, differentiation, integration, environmental sensitivity and awareness. The data confirmed these predictions.

The preceding studies indicate that reflection-impulsivity is related to persistence, verbal ability and achievement in certain subject areas. The relationship to persistence appears to have relevance for the present study since persistence may be related to dependency of an individual to be more reflective. Conceptual level (in terms of the concrete-abstract dimension) appears to be related to a number of variables, such as socio-economic status, sex, grade-point average and structure for decision-making. The last of these relate to the present study.

Interaction between environmental and dispositional factors. Driver (1962) in a study of integratively simple and complex individuals utilized a simulation game to attempt to determine the effect of complexity of environment on complexity of performance by persons in both categories. He found that those individuals considered to be integratively simple,

performed significantly better in a complex situation than those integratively simple individuals in a simple situation. These findings allow some optimism for those interested in a training effect. It appears that a complex environment enhances the performance of persons who are integratively simple.

Sieber and Lanzetta (1964) conducted a study of decision-making by persons with abstract or concrete conceptual structures. Conceptual level was measured by the Sentence Completion Test of Schroder and Streufert. The test was administered to 332 students at the University of Delaware. The 15 most abstract and 15 most concrete students were selected to participate in the study. Subjects were presented with 20 decision problems (identification of objects depicted on slides which were presented tachistoscopically). Problems varied in degree of uncertainty with 10 regarded as solvable and 10 as unsolvable. In addition, 3 levels of importance were imposed (low, medium and high) on different subjects.

Results indicated that information search or differentiation was greater for abstract students, in comparison to concrete students, under each condition. However, the amount of information search amongst the abstract students was curvilinearly related to importance. Analysis of variance indicated a significant relationship between information search and problem uncertainty. Information search was found to increase in proportion to uncertainty for abstract persons but was not related to problem uncertainty for concrete

individuals.

Sieber and Lanzetta conclude that conceptual level appears to be an important factor in decision-making behaviour. They feel that the data support the motion that abstract persons perceive more dimensions of information and habitually seek more information in order to have a more comprehensive map of their environment. These findings support the use of a decision-making task as the dependent variable in the present study.

Streufert, Clardy, Driver, Karlins, Schroder and Suedfeld (1965) designed a tactical game to measure the effect of changes in information load upon integrative complexity of output. The measures of output complexity used for the analysis of the data yielded information about strategic integrations that a team makes and carries out. The results clearly indicated that teams of integratively complex persons (measured by Sentence Completion Test) based their actions on a higher level of informational integration and develop higher level strategies. In all cases, integratively complex teams developed more complex decision-making strategies than integratively simple teams. The concrete teams were characterized by a simpler reliance upon the immediately given factors. With concrete teams there was a tendency towards adopting generalized strategies often developed on the basis of insufficient information.

Streufert and Schroder (1965) studied the relationship of environmental complexity (in terms of information load) to information processing performance (in terms of mean number of integrations) by abstract and concrete individuals.

The Sentence Completion Test was administered to 236 male students at three universities, in order to determine their conceptual structure. The forty highest and forty lowest scoring subjects were selected and grouped in homogeneous (in terms of conceptual level) four man teams.

The teams were given the task of making decisions regarding the invasion of a mythical island. Groups of subjects were exposed to seven differing load conditions. For purposes of analysis, integration was defined as any connection between one decision and another where it could be said that the first decision was used as a basis for the later decision.

Results showed that the number of integrations for both abstract and concrete teams increased as information load increased from two to ten independent statements. There was a decrease in the number of integrations, above ten statements, for both concrete and abstract groups. Abstract groups in all cases showed a higher number of integrations. Analysis of variance showed main effects for load and conceptual level ($p < .01$). However, evidence of an

interaction effect was lacking. Thus, there appear to be no differences between abstract and concrete groups concerning load conditions which would lead to maximal performance.

Kagan, Pearson and Welch (1966b) conducted a study in which they attempted to vary the training environment in order to determine if a change would occur in the conceptual tempo of individuals. The object was to see if impulsive children would become more reflective as a result of specific training conditions. The first training condition was a normally nurturant one between child and tutor. In the second condition the child was persuaded to believe that by becoming reflective he could increase the pool of shared characteristics.

The subjects were 155 grade one students. They were administered the MFF test and two verbal scales of the WISC. Each student was subjected to three fifty minute training sessions under one of the two conditions. Results of the study showed that the only important effect of training was to lengthen response time on the MFF test. The training procedure produced response latencies that matched those of normal reflectives. Error scores, however, were not significantly affected by training. Therefore, the hypothesis concerning the facilitating effect of perceived similarity to the trainer was not supported.

Ward (1968) analyzed reflection-impulsivity by

examining the generality of this disposition through two variations in its measurement. Several new tests were devised and two testing contexts were employed. One of these contexts was to inform the child of his errors while the other was to accept and praise all responses. Ward hypothesized that it was possible that the reason Kagan failed to find any differences when examiners used either impersonal or reassuring roles was the failure to eliminate feedback.

The sample involved in Ward's study consisted of 41 males and 46 females at the kindergarten level. Results showed no sex difference on latency scores and only one significant difference on errors with females making significantly fewer errors on one of the variation tests. No significant differences were found in latency scores when children were grouped on the basis of age and intelligence. Ward also tested the hypothesis that response latency would increase after the child had been informed of an error. He found that impulsive children showed a significant tendency to choose more carefully following errors. This conflicts with Kagan's view that the impulsive child is anxious over the possibility of failure and responds quickly to avoid the discomfort he would feel during the delay needed for careful choice (Kagan et al., 1964).

The data from this study support the generality and pervasiveness of the dimension of reflectivity-impulsivity in terms of individual differences in information processing style. However, it is clear that situational variables as well as factors intrinsic to the child, play a role in effecting reflective or impulsive performance.

Yando and Kagan (1968) conducted a study to determine if a child's conceptual tempo (reflection-impulsivity) could be changed in a situation where he had ample opportunity to observe, and perhaps imitate, a reflective or impulsive model (teacher). The sample consisted of a random selection of 80 boys and 80 girls from the first grade classrooms of ten impulsive and ten reflective teachers with differential experience. The students were administered the MFF test during the first week of school in the fall and a different form of the MFF in the spring.

Results indicated that both boys and girls in the classrooms of experienced reflective teachers (experience greater than eight years) showed sizable increases in response time with the boys showing a significant increase. The critical result was the significant interaction of style and experience. Neither experience or sex alone yielded significant effects for response time. In addition to the finding that response times were increased, they

found that error scores were not altered appreciably.

Tuckman (1968) investigated the interactive effects of learner conceptual level with degree of structure represented by non-directive and directive teachers. Conceptual evel was indexed through the use of an ojective test (Interpersonal Topic Inventory). Tuckman followed the matching model rationale to predict matching effects for low conceptual level students with directive teachers and high conceptual level students with non-directive teachers. When measures of teacher preference, satisfaction and course grade were analyzed, the hypotheses were confirmed with the low conceptual level students performing at a higher level under directive teachers and the high conceptual level students performing better under non-directive teachers.

McLachlan (1969) investigated the interactive effects of learner conceptual level and variations in structure represented by discovery (low structure) and lecture (high structure) situations. Equal numbers of low and high (conceptual level) students were matched on ability and assigned to each of the two conditions. Students were shown pictorial materials consisting of a slide with an entire picture and several slides containing component parts of the picture. Students in the lecture condition heard a short lecture on the meaning of each slide while those in the discovery condition viewed each slide for the same amount of time but were told to work out the meaning by themselves.

Later, students were asked to give the central meaning of the picture and to describe how the parts fit together (integration). In addition they were asked to recall and answer questions. Results indicated an ordinal interaction with low conceptual level students performing significantly better ($p < .05$) with high structure and no difference among high conceptual level students under either condition.

Tomlinson and Hunt (1970), in a report on Tomlinson's (1969) thesis, looked at the interaction between three types of classroom structure (Low, Intermediate and High), based on rule-example sequence and contiguity, and conceptual level of the student.

The subjects in this study were 160 grade eleven students in Ontario. Each student was administered a Paragraph Completion Test to determine conceptual level. The low structure situation consisted of examples only; intermediate structure consisted of examples then a statement of the rule; and the high structure consisted of presentation of the rule followed by examples.

The results of this study indicated a highly significant conceptual level by treatment effect. Under low and intermediate structure the low conceptual level groups were significantly lower ($p < .05$) than the high conceptual level groups under these two structures. The low conceptual level groups, under low and intermediate structure, were also significantly lower than

the low conceptual level group under high structure. Although there was a tendency toward disordinal interaction, it was not significant.

Hunt and Joyce (1967) conducted a study to determine the relationship of conceptual level (measured by the Sentence Completion Test) to reflective teaching style (defined as helping the child evaluate information, raise hypotheses, make inferences, define or advance a problem and help child to find information). The subjects were fourteen graduate students in education. Teaching style was assessed on the basis of taped lessons which were coded according to Joyce's, *Manual for Coding Teacher Communications*. Analysis indicated a correlation between conceptual level and reflective index of .578 ($df = 12$, $p < .05$). The possible biasing effects of general intelligence were considered. However, a zero correlation was found between intelligence and conceptual level as well as the reflective index. Hunt and Joyce state that it is reasonable to conclude that the relationship between the conceptual level of the teacher and the capacity to radiate a reflective environment has been established.

Murphy (1970), in a later study also considered the relationship between the teacher's conceptual system and teaching style. In this study, 136 student teachers at three Midwestern universities were administered Harvey's

Conceptual Systems Test and Schroder's Paragraph Completion Test to determine their conceptual level. Teacher style was assessed using Joyce's *Manual for Coding Teacher Communications*. This was applied to a twenty minute audio tape segment selected at random. The results indicated that teachers characterized by more concrete conceptual systems tended to handle information by questioning for precise answers (Recitation Style). Teachers characterized by more abstract conceptual systems handled information by helping students theorize and helping students toward self-expression (reflective-style). Murphy tentatively concludes that the conceptual system of the teacher influences teaching style.

Summary

The studies reviewed dealt with reflection-impulsivity and the constructs related to differentiation (conceptual level and integrative complexity) in terms of their effect on student performance as well as the interaction of student aptitudes with particular environments. The findings indicate that one aspect of the reflection-impulsivity dimension (response latency) may be modified by the teacher. Specifically, students in the classrooms of experienced reflective teachers showed increases in response latency. It was also found that performance of students, with low or high conceptual levels, varied according to the

degree of structure in the environment. This emphasizes the importance of the environment produced by the teacher in determining student performance. Finally, there were two studies reported which suggested that there is a relationship between the conceptual level of the teacher and the type of environment that the teacher generates. This is of importance to the present study since it is assumed that teachers with different information processing styles will produce different instructional environments for their pupils.

On the basis of the theories that have been discussed and the review of research, the following section identifies the theoretically expected outcomes in the present study.

Theoretically Expected Outcomes

Assumptions. The hypotheses listed below are based on the assumption that the instructional environment affects student performance. In the present study it is assumed that the teacher is the major determinant of the type of instructional environment that is created. In addition, it is assumed that the information processing style of the teacher, in terms of differentiation and reflection is a major determinant of the way the teacher instructs.

Hypotheses. On the basis of the theories outlined in the preceding section it is hypothesized in the present study that:

I. There will be a significant difference in the decision-making performance of students who are categorized on the basis of their information processing styles.

II. There will be a significant difference in the decision-making performance of students who are exposed to different environments which are represented by teacher information processing styles.

III. There will be a significant student-teacher interaction effect on the decision-making performance of students when students and teachers are categorized on the basis of differentiation and reflection - impulsivity.

With reference to the last hypothesis, it is possible that teachers who are high differentiators will tend to categorize students on the basis of more dimensions. It is postulated that teachers who differentiate more highly among students are better able to assess students needs and alter the instructional strategies to meet these needs. This should lead to better performance by all students in the classes of high differentiating teachers. The low differentiating teacher is not likely to differentiate as greatly among students and, therefore, is likely to use the same instructional strategies for all students. Therefore, the performance of students will depend more on their own style of information processing than on the teachers'.

It is also postulated that reflective teachers

are likely to provide an environment which emphasizes consideration of more possible alternative courses of action (differentiation and integration) and to encourage students to take more time in making decisions. Impulsive teachers, on the other hand are likely to encourage quick responses and to de-emphasize the importance of considering many possible alternatives.

In addition to the overall main effect of different environments, it is predicted that there will be a significant student main effect because of the nature of the performance task. If there were no environmental interaction, then it would be predicted that high differentiating students would do better than low differentiating students and that reflective students would do better than impulsive students.

On the basis of the postulated differences in environments for learning, predictions about the performance of students who are in the classroom of teachers with different information processing styles are as follows:

(1) *High Differentiating-Reflective Teachers* encourage students to differentiate information on many dimensions, to assess carefully and to take time in responding. In this environment it is predicted that the high differentiating-reflective student will perform significantly better than all other

students. The high differentiating impulsive student is likely to be second in performance since he is capable of differentiating and the environment will moderate his decision making time. It is also predicted that the low differentiating-reflective students will perform better than their counterparts in other environments since this environment will encourage them to differentiate and since they are already reflective. The low differentiating-impulsive student will likely do very poorly since he does not have the ability to differentiate and also tends to answer quickly. His style of information processing is so far removed from the environment he is in that despite the efforts of the teacher he is less likely to perform the decision-making task successfully.

(2) *High Differentiating-Impulsive Teachers* encourage students to differentiate but expect quick responses. This may lead to confusion on the part of the student. The high-differentiating-reflective student will likely perform better than other types of students in this environment since they might tend to resist the emphasis on speed. The high differentiating-impulsive student will do less well since he has a large number of dimensions upon which he has differentiated information yet chooses quickly

instead of weighing alternatives carefully. The low differentiating reflective student should be better than the high differentiating-impulsive student since he has differentiated few dimensions and is less confused when making a choice even though he may be pushed by the teacher's emphasis on speed. The low differentiating-impulsive student should be relatively successful in this environment since he is used to selecting quickly and has only a few dimensions which he differentiates.

(3) *Low Differentiating-Reflective Teachers* encourage students to take their time but fail to distinquish among students to any degree. All students are treated in a similar manner. The high differentiating-reflective student will likely do best because of the nature of this environment. The high differentiating-impulsive student will do next best since the environment will encourage him to take his time in making decisions. The low differentiating-impulsive student will have the lowest performance score under these circumstances. The low differentiating-reflective student will perform only slightly better than the low differentiating-impulsive student. In other words, the effect of this environment is probably minimal for all students and the performance of students will depend more on their own style of information processing than

that of the teacher.

(4) *Low Differentiating-Impulsive Teachers* encourage students to answer quickly. They are not likely to differentiate among students or to encourage students to assess information on a large number of dimensions. In this environment the high differentiating-reflective students should perform at a high level since the environmental effect is thought to be minimal because of the failure of the teacher to differentiate. The high-differentiating-impulsive student should be next in performance. The low differentiating-reflective student is likely to do worse than the low differentiating-impulsive student due to the emphasis on time in this environment.

The predicted performances of the various types of students situated in different environments are outlined in Table 1. In this table, high differentiating and reflective aptitudes are seen as positive while low differentiating and impulsive styles are seen as negative. by using these weights the first row of positives and negatives in each cell has been derived. However, in certain cells a disordinal interaction is predicted. This may be positive or negative and means that student performance is expected to be different than what would normally be expected on the basis of the sum of the positive and

negative values. As asterisk in a cell indicates that a disordinal interaction is predicted.

Summary

On the basis of the theories of information processing and matching outlined at the beginning of this chapter as well as the review of the research, a number of hypotheses were formulated and expected outcomes were predicted. Chapter III outlines the design of the present study and describes the instruments and methods of analysis used to test the hypotheses.

TABLE I

THEORETICALLY EXPECTED OUTCOMES OF
STUDENT-TEACHER INFORMATION PROCESSING STYLES

Teachers / Students	High Differentiating-Reflective		High Differentiating Impulsive		Low Differentiating Reflective		Low Differentiating Impulsive	
High Diff. Ref.	+ +	+ +	+ +	+ -	+ +	- +	+ +	- -
High Diff. Imp.	+ -	+ +	+ -	+ - *	+ -	- +	+ -	- -
Low Diff. Ref.	- +	+ +	- +	+ - *	- +	- +	- +	- - *
Low Diff. Imp.	- -	+ +	- -	+ - *	- -	- +	- -	- - *

* Indicates where disordinal interactions are predicted.

CHAPTER III

RESEARCH INSTRUMENTS & PROCEDURES

Introduction

In order to investigate the problem selected for study, three research instruments were developed. The Children's Differentiation Test (CDT) was constructed to collect data on the method used by children to process incoming information. The Adult Differentiation Test (ADT) was designed to collect the same type of data from the teachers involved in the study. The third instrument developed was the Decision Making Test (DMT) which was used as the criterion measure of student performance.

In addition, Kagan's Matching Familiar Figures Tests (Children's and Adult Versions) were administered to students and teachers.

Development of the Children's Differentiation Test

An attempt to develop a measure of differentiation was made by Kelly (1955) who developed the Role Concept Repertory Test (Rep). This test is quite complex in that it requires the subject to identify persons in the environment who meet certain role descriptions (such as boss, best friend). The individuals who are identified are then grouped into sets of three. For each group the subject is required to name a dimension on which two of the persons are different from the third. In this way a pool of dimensions is derived. One criticism of the Rep. Test

is that subjects can only generate as many dimensions as there are triads and this may result in the artificial grouping of moderate and high differentiating subjects (Schroder, Driver and Streufert, 1967).

Schroder and his colleagues (1967) suggest that the Rep. Test might be converted into a more effective measure of differentiation if pairs of individuals were compared by the subjects rather than forming triads.

In addition, to the criticisms outlined above, the Rep. Test is not suitable for administration to young children. Therefore, the Children's Differentiation Test (CDT) was developed by the researcher, to measure the ability of children at a grade six level, to differentiate information on various dimensions. The test (Appendix A) consists of two short stories about two fictitious children living on different planets. These particular types of stories were chosen in order to minimize the effects of background knowledge of the respondents.

The short stories supply information about two fictitious children. The reader is then asked to write in his own words a statement which contrasts the personal and environmental characteristics of the two children. The number of dimensions upon which the respondent differentiates the information that is presented, determines his score on the test. It is assumed that the more dimensions he

uses to differentiate the children in the stories, the greater is his differentiating ability.

If close to the maximum number of possible dimensions (as determined in the pilot study) are differentiated, then the respondent is considered to be high on the differentiation continuum. If a minimal number of contrasts is made, then the respondent is considered to be low on the differentiation continuum. The various dimensions are not weighted. Therefore, for each dimension that is differentiated by the respondent a score of one is given. The scoring of the CDT involves the reading of the respondents' list of differentiated dimensions. This is then compared with the scoring key (Appendix B) which lists all the possible dimensions which may be differentiated. For each dimension that the respondent differeniates he is given a score of one. The total possible score on the CDT is 15.

Validity. On the basis of the construct of differentiation outlined by Kelly (1955) as well as the Rep. test which he developed, the Children's Differentiation Test appears to be measuring the construct of differentiation. As Cronbach (1971) has pointed out, "Construction of a test itself starts from a theory about behaviour or mental organization." In the present situation, the CDT appears to have face validity or construct validity in that

it appears to be a measure of the construct of differentiation. This is only a first step in the validation of a new instrument but as Cronbach (1971) goes on to say, "To conduct all the studies that may be relevant to a given test is far beyond the resources of a test developer."

In order to develop a scoring key and to ensure that the Children's Differentiation Test did indeed discriminate among students, the instrument was administered to a number of sixth grade children in an elementary school located in Edmonton. A list of the dimensions that were differentiated by this group of students is shown in Appendix B. It was also found that the instrument did discriminate among students since scores ranged from zero to fifteen.

In addition the Children's Differentiation Test was subjected to Fry's (1968) readability formula. This formula involves selection of a one-hundred word section of the material. The number of sentences (in this sequence) is determined and the number of syllables found in the hundred words. These figures are then applied to a graph developed by Fry. The graph indicates the approximate reading level of the material in terms of grade level. This formula correlates highly ($p < .05$) with other formulas such as the Science Research Associates, the Dale-Chall and the Flesch (Fry, 1968). On the basis of this formula the Children's

Differentiation Test was found to be at a grade five reading level.

Reliability. The test-retest realibility of the Children's Differentiation Test was determined by administering the CDT to a class (N=32) of students not involved in the study. Five weeks later the test was re-administered and a Pearson correlation run between the two sets of scores. The correlation was .832 ($p < .000$).

Development of the Adult Differentiation Test (ADT)

The Adult Differentiation Test (Appendix C) was also developed by the researcher in order to assess information processing styles of adults. The test is based on the same theory as the CDT. The ADT consists of two case histories of boys which the respondents are asked to contrast. The scoring of the ADT involves reading the respondent's list of dimensions upon which he differentiates the boys. This list is then compared to the scoring key (Appendix D). For each contrast the respondent lists, he is given a score of one. The total possible score is 34. The respondent who differentiates close to a maximum number of dimensions (as determined by means of a pilot study) is considered to be high on the differentiation continuum while the respondent who lists only a minimum number of dimensions is considered to be low on the differentiation continuum. The list of possible contrasts for the ADT is shown in Appendix D.

Validity. The Adult Differentiation Test is based on Kelly's (1955) construct of differentiation. As with the Children's Differentiation Test, the Adult version appears to have construct validity. The same limitations apply to this instrument as to the Children's Differentiation Test in the sense that face validity is only a first step in test validation.

In order to develop a scoring key and to ensure that the Adult Differentiation Test did indeed discriminate among respondents, the instrument was administered to three classes of fourth year students (N=62) at the University of Alberta in order to develop a scoring key consisting of the total number of possible dimensions differentiated by this group (who might be considered above the normal adult level of intelligence but within the normal range for teachers). Also, the administration of this instrument was used to ensure that it did indeed discriminate among respondents. The results indicated that discrimination did occur and that the range of scores could be used to classify respondents as high or low on the differentiation continuum.

Decision Making Test (DMT)

The DMT was adopted from a workbook exercise developed by Science Research Associates to correlate with the unit of the Social Science Resource Units used by teachers during the instructional phase of this study.

The DMT (Appendix E) consists of a story about a boy who faces a dilemma which involves his peer group. The facts of the case are presented in the story. The respondent is informed that the boy has a number of alternative ways of coping with the dilemma. These alternatives are presented to the respondent. The respondent is then asked to rank the decisions in order of preference. For example, the respondent would rank the decision he considered to be best as one and the decision he considered to be the poorest as six.

The DMT was scored by giving the respondent six points if he chose the best decision (determined by a panel of judges) as number one, five if he chose the second best decision as number two and so on. No score was given if one of the alternative decisions was not chosen correctly. For instance, if the best decision was chosen as number two the respondent received no score. The total possible score on the DMT was twenty-one.

Validity. Lippit, Fox and Schaible (1969) constructed the workbook exercise from which the Decision Making Test has been adapted. The fact that these authors supply this exercise as a decision-making task, implies that the task has construct validity in the minds of the authors.

A scoring system for the DMT was derived by having three judges (professors at the University of Alberta) rank

the six possible alternatives in order of preference. In all cases, but one, the judges ranked the decisions in the same order. In the one exception, two of the three judges agreed and this majority opinion was used for scoring purposes.

Matching Familiar Figures (MFF)

This measure was developed and has been most frequently used by Kagan and his associates (Kagan 1965; Yando and Kagan, 1968). The MFF is made up of a number of problems which consist of a standard figure such as the line drawing of an ocean going ship. The respondent is then presented with several variants of this standard such as six line drawings of the same ship but with some noticeable difference in all cases except one. The subject is required to find the one variant which is identical to the standard (Appendix F). Response latency in seconds and number of errors are both calculated. The test is primarily a perceptual one which requires the respondent to match line drawings. The children's version has six variants and the adult version eight variants.

In both versions of the test, the respondent is presented with a line drawing of some object (house, dog, cowboy, etc.). Below this there are six or eight similar line drawings of the same object. The line drawings become more difficult as one progresses through the test. In

each of the versions there are comparisons to be made. The respondents are initially given two samples in order to become aware of the nature of the test. In each case only one of the six or eight variants is identical. The respondent is timed with a stopwatch from the moment he is shown the pictures until he selects the identical picture below. Each time the respondent selects the incorrect variant it is counted as one error. Both the time in seconds and errors are recorded. Those who are above the mean of the group on latency and below the mean on errors, are categorized as Reflective. Those who are below the mean of the group on latency and above the mean on errors are categorized as Impulsive.

Sample

Teachers. Teachers employed by the Edmonton Separate School System were approached to participate in this study. The initial sample of teachers included all those who met the following criteria:

1) held a Bachelor's Degree
2) had a minimum of three years' teaching experience.
3) were currently teaching grade six Social Studies.

The total number of teachers in the Edmonton Separate School System who met these criteria, was twenty-eight.

All twenty-eight teachers were invited by the researcher to be tested in order to assess their infor-

mation processing styles. The teachers were informed that if they were selected to participate in the final study, they would be involved in teaching a Social Studies Unit for which materials would be supplied by the researcher.

Twenty-six of the twenty-eight teachers indicated a willingness to participate. These twenty-six teachers were then approached to be tested individually by the researcher. These were administered the Adult Differentiation Test and the adult version of Kagan's Matching Familiar Figures Test. Thus for all teachers who met the criteria listed above, the researcher obtained a differentiation score, a response latency score and an error score by which they could be categorized as reflective or impulsive.

On the basis of their scores, these teachers were categorized as high or low on differentiation and as either reflective or impulsive.

After categorization of all teachers on the aptitudes of differentiation and reflection-impulsivity two teachers were selected for the study from each of the following categories: high differentiating-reflective; high differentiating-impulsive; low differentiating-reflective; low differentiating-impulsive. These teachers were those at the extremes in each category. For instance the two teachers who had the highest differentiation score and also the most reflective score were chosen for the

high differentiating-reflective category. The total number of teachers participating in the study was eight.

Students. The student sample consisted of those students registered in the classes of the eight teachers selected for the study. The total number initially was 208. Due to absence on testing days or lack of data on students this was reduced to a final number of 175 pupils. A further reduction of students used in the final analyses resulted from attrition due to categorization on the reflection-impulsivity continuum. The final sample consisted of 125 pupils.

Procedure

Individual tests (Matching Familiar Figures) as well as group tests (Children's Differentiation Test) were administered to the student sample. In addition, data on age, intelligence quotient, and reading level were obtained for each pupil.

Unit Description

Following the testing of students, teachers were asked to teach a commercially prepared unit in Social Studies. The unit selected for the study was developed by Lippit, Fox and Schaible and entitled *Social Science Laboratory Units* (Lippit, et al., 1969). Teachers were asked to teach the section entitled *Learning to Use Social Science.* The unit was taught over a six week period.

The Unit entitled *Learning to Use Social Science* is concerned with how social scientists operate. Teachers using the unit are to emphasize the importance of observing the behaviour which characterizes certain individuals. Several examples of behaviour specimens are presented and the students are involved in discussions of these with particular emphasis on differences among factual description (of what is actually observed), inferences (possible explanations as to why something occurs) and value judgements (whether behaviour is good or bad). The unit also deals with cause and effect relationships, multiple causation, circular processes (in relation to causes of behaviour), prediction testing and interviewing techniques.

This particular unit was chosen since the decision-making test, which was used as the criterion task, involves a description of a boy's behaviour from which students are to sort out factual observations, inferences and value judgements. The task then involves ranking six possible decisions which the boy in the story could make in order to solve his problem.

The function of the unit was to prepare the student to deal with the criterion task. The unit was not considered to be a treatment in itself. The information-processing style of the teacher is the treatment and is the variable which is being investigated.

The fact that this was a commercially prepared and tested unit eliminated some variables such as teacher selection of content, which may have affected the study. In this way every teacher received the same materials to be used for instruction. The materials included texts, a resource book entitled; Teacher's Role in Social Science Investigation; (Lippit, Fox and Schaible, 1969), Teacher's Guide and a set of tape recordings. The unit was taught over a six week period; however, the total number of hours of instruction may have varied somewhat for individual classes.

Upon completion of the instructional phase, the students were administered a Decision-Making Test (described in this chapter) which was used to obtain criterion scores for pupils.

Limitations. There are several apparent limitations in the design of the study and in the instruments that were used. An important limitation relates to the theoretical bases for the study. The constructs of cognitive style and person-environment matching are relatively recent developments in educational research and only initial explorations have occurred. As a result there is little solid evidence upon which research studies may be based. Therefore, studies in this area are exploratory in nature.

The limitations in the design of the study are re-

lated to the fact that only two teachers representing each information processing style category were used. In essence, this means that a sample of two is being used in some analyses. Obviously, this has an effect on the generalizability of results.

A further limitation involves the development and validation of the Children's and Adult's version of the Differentiation Test. Although these tests have construct validity in Cronbach's (1971) terms, the instruments are only in their initial stages and it is hoped that further validation will occur in future studies. As Cronbach (1971) has pointed out, "...construct validation is best seen as an ever-extending inquiry into the processes that produce a high or low test score (p. 452)."

Summary

This study was designed to investigate the nature of the interaction which takes place between students and teachers in terms of their information processing styles. The effects of these styles, and the interaction between teacher and pupil styles is assumed to affect the decision-making performance of students.

In order to investigate this problem it was necessary for the researcher to develop two instruments based on theories of information processing in order to assess differentiating ability of teachers and students. In

addition, Kagan's Matching Familiar Figures Test was used to determine reflection-impulsivity of teachers and students.

Teachers employed by the Edmonton Separate School System who met certain criteria were invited to participate in the study. Twenty-eight teachers met the criteria and of those, twenty-six indicated a willingness to participate in the study. These twenty-six teachers were tested and on the basis of test results were placed into four categories. Two teachers in each category were chosen for this study.

Pupils in the classes of the eight teachers selected on the above basis formed the student sample for the study (N=125). These students were tested individually using Kagan's Matching Familiar Figure Test and on a group basis using the Children's Differentiation Test.

The instructional phase of the study involved the teaching of the unit on *Learning to Use Social Science* from the *Social Science Laboratory Units* developed by Lippit, Fox and Schaible and published by Science Research Associates (1969). Upon completion of the unit the pupils were administered the Decision-Making Test (adopted from a workbook exercise developed by Lippit, Fox and Schaible, 1969) which was then utilized as the criterion score.

Chapter IV considers the findings of the study based on the analysis of data gathered from administration of the instruments, described in this chapter, to the subjects selected for participation in this study.

CHAPTER IV

DATA ANALYSES AND DISCUSSION

Introduction

The hypotheses proposed for this study were tested using an analysis of variance design. The programs used were BMDX 64 which was developed and documented by the Health Sciences Computing Facility at the University of California in Los Angeles and ANOV 15 which was developed by the Division of Educational Research Services, University of Alberta. Data for the analyses were provided by the students' scores on the Children's Differentiation Test; Kagan's Matching Familiar Figures Test (Children's Version) and the Decision Making Test.

Findings and Observations

Correlations. Data were initially subjected to a Pearson product-moment correlation program to determine relationships among all sets of data including test scores, criterion scores, information processing styles (differentiation and reflection-impulsivity) of teachers and students, intelligence quotient, reading score and sex (Table II). Significance at the .05 and .01 levels is indicated by single and double asterisks.

The correlation between differentiation and reflection-impulsivity scores was not significant for teachers

TABLE II

INTERCORRELATION BETWEEN TEACHER AND STUDENT INFORMATION PROCESSING STYLES, STUDENT STYLES AND ABILITY MEASURES, AND CRITERION SCORE (PEARSON PRODUCT-MOMENT CORRELATION)

VARIABLES	1	2	3	4	5	6	7	8	9	10
1. Teacher Reflectivity-Impulsivity	1.000									
2. Teacher High-Low Differentiation	-.011	1.000								
3. Student Reflectivity-Impulsivity	-.154	.072	1.000							
4. Student High-Low Differentiation	-.236**	.007	.143	1.000						
5. Student Decision-Making (Criterion) Score	-.055	.179*	-.086	.192*	1.000					
6. Student I.Q.	-.076	-.248**	.113	.309**	.114	1.000				
7. Student Reading Score	-.213**	-.218**	.145	.359**	.084	.783**	1.000			
8. Children's Differentiation	-.252**	.043	.213*	.788**	.154*	.413**	.502**	1.000		
9. Student Age	-.066	.225**	.111	.063	.012	-.326**	-.055	.115	1.000	
10. Student Sex (M-F)	-.114	-.059	.207*	.101	-.034	.070	-.013	.076	-.098	1.000

* p .05 ** p .01

or students. It was expected that a relationship might have existed between differentiation and reflection-impulsivity, despite the different contexts of the measuring instruments. However, this was not the case. The analysis did indicate that there was a significant ($p < .01$) negative relationship between student differentiation and teacher reflection-impulsivity. This indicated that reflective teachers had a greater number of low differentiating students in their classrooms.

A significant correlation ($p < .05$) was found between student decision-making scores and both student and teacher differentiation scores. In addition, the intelligence test scores were found to have a significant ($p < .01$) relationship to both teacher (negative) and student (positive) differentiation scores.

The students' scores on the Children's Differentiation Test were found to have a significant negative correlation ($p < .05$) to teacher reflection-impulsivity. In other words, teachers with high impulsivity scores had more students in their classrooms with high differentiation test scores.

The Children's Differentiation Test scores correlated significantly ($p < .05$) and positively with student Decision-Making scores, student intelligence test scores and reading scores.

A significant ($p < .05$) correlation between sex and reflection-impulsivity was also found. This concurs with the findings of Kaygan and his associates who also found that females are more reflective. This sex bias was not evident in the case of student differentiation scores in this study.

Analysis of Variance

One-way Analysis of Variance (ANOV 15) was used to determine if any significant differences existed among the eight classes of students participating in the study. The analysis indicated that there were no significant differences in the decision-making scores among classroom groups of students (Table III).

Analysis of variance was used to determine if significant differences in decision-making scores of students resulted from differences in student style of information processing, teacher style of information processing or from the interaction of student and teacher information processing styles.

The analysis was conducted on a two by two by two by two matrix constructed on the basis of teacher and student information processing styles. Both students and teachers were initially divided on the basis of differentiation, then subdivided on the basis of reflection-impulsivity. The number of subjects in each of the 16 cells in the matrix is shown in Table IV. The mean scores of the subjects in each cell, on the

TABLE III

ANALYSIS OF VARIANCE AMONG EIGHT CLASSES OF STUDENTS IN TERMS OF DECISION-MAKING SCORES

Source	Sum of Square	Mean Score	df	F
Groups	0.135	19.33	7	1.03
Error	0.219	18.71	117	

TABLE IV

NUMBER OF SUBJECTS IN EACH CELL USED FOR ANALYSIS OF DIFFERENCES AMONG STUDENT DECISION-MAKING SCORES WHEN STUDENTS AND TEACHERS ARE CATEGORIZED ON THE BASIS OF INFORMATION PROCESSING STYLES

		Students			
Teachers		High Differentiation		Low Differentiation	
		Reflective	Impulsive	Reflective	Impulsive
High Diff.	Ref.	5	6	7	9
	Imp.	8	3	7	13
Low Diff.	Ref.	16	5	11	4
	Imp.	10	5	11	5

decision-making task, is shown in Table V.

The main and interaction effects due to the information processing styles of both teachers and students plus the interaction of these styles, is summarized in Table VI.

The analysis of variance indicated that no significant differences in student decision-making scores were due to the effects of teacher reflection-impulsivity, teacher differentiation, or student reflection-impulsivity. This finding is not consistent with the theories discussed in Chapter II. Biggs (1972) suggests that reflection follows differentiation in the processing of information and, therefore, it was expected that decision making scores of students would be affected by both these styles of information processing. This is not the case, either for teachers or students as measured in this study. In fact, there appears to be no significant main effect of teacher information processing styles on student decision-making scores.

The finding that student reflection-impulsivity has no main effect on student decision-making scores was not expected. Kagan and his associates have suggested that this construct is widely based and affects performance on several different types of tasks. It should also be noted that the Matching Familiar Figures Test is purportedly based on differentiation and integration ability as well as on the ability

TABLE V

MEAN DECISION-MAKING SCORE OF STUDENTS IN EACH CELL

Teachers		Students			
		High Differentiation		Low Differentiation	
		Reflective	Impulsive	Reflective	Impulsive
High Diff.	Ref.	1.2	10.6	5.2	3.6
	Imp.	4.6	6.5	3.0	6.0
Low Diff.	Ref.	7.4	4.0	3.3	3.0
	Imp.	4.4	5.6	1.4	.8

TABLE VI

SUMMARY OF ANALYSES OF VARIANCE AMONG
INFORMATION PROCESSING STYLES OF STUDENTS AND TEACHERS

	VARIABLES	SUM OF SQUARE	MEAN SQUARE	df	F
A	Teacher Reflection Impulsivity	13.897	13.897	1	0.886
B	Teacher High-Low Differentiation	45.312	45.312	1	2.889
AB		10.261	10.261	1	0.654
C	Student Reflection Impulsivity	36.337	36.337	1	2.317
AC		0.802	0.802	1	0.05
BC		98.390	98.390	1	6.273*
ABC		21.232	21.232	1	1.354
D	Student High-Low Differentiation	130.058	130.058	1	8.293**
AD		1.336	1.336	1	0.085
BD		24.087	24.087	1	1.536
ABD		5.684	5.684	1	0.362
CD		29.713	29.713	1	1.895
ACD		21.229	21.229	1	1.354
BCD		48.688	48.688	1	3.104
ABCD		116.688	116.345	1	7.418**

* $p < .05$ ** $p < .01$

to select alternatives. If this is so, one would expect a significant difference in decision-making scores of students who are grouped on the basis of reflection-impulsivity since the criterion task appears to require similar information processing skills as does the MFF test, but in different contexts.

The only significant ($p < .01$) main effect due to student information processing style was on the style of differentiation. This may be interpreted as indicating that student scores on the decision-making test are significantly affected on the basis of whether a student is a high or low differentiator. Students who are high differentiators do better on a decision-making test than do students who are low differentiators. This is consistent with the previously discussed theories of Harvey, Hunt and Schroder (1961), Schroder, Driver and Streufert (1967) and Biggs (1968, 1969, 1972). All of these theories suggest that the individual who is capable of differentiating information on several dimensions, is more likely to have a greater number of bases for decision-making and, therefore, is more likely to make a better decision.

The first interaction effect revealed by analysis of variance was between teacher differentiation and student reflection-impulsivity. This indicates that there may be a significant difference in the decision-making performance

of reflective and impulsive students if they are situated with teachers who are high or low on differentiation.

The mean scores of reflective and impulsive students who are in the classrooms of high and low differentiating teachers are shown in Table VII. Plotting of the mean scores of reflective and impulsive students who are situated in the classroom of high and low differentiating teachers revealed a crossover or disordinal interaction. This is shown in Figure II. The plotting of this interaction suggests that the decision-making performance of reflective students is lower when these students have a high differentiating teacher. However, the decision-making performance of impulsive students is higher when they are situated with high differentiating teachers. These findings might be explained in theoretical terms by considering the matching models discussed in Chapter II. This finding supports, to some extent the compensatory model proposed by Mogar (1969) and also by Snow (1969). The compensatory model suggests that the information processing style of the teacher should compensate for the student's weakness on a particular aptitude. The findings in the present study suggest that this may be the case since the impulsive students, who generally are not considered to differentiate on a large number of dimensions did well with high differentiating teachers. Alternatively, the reflective students

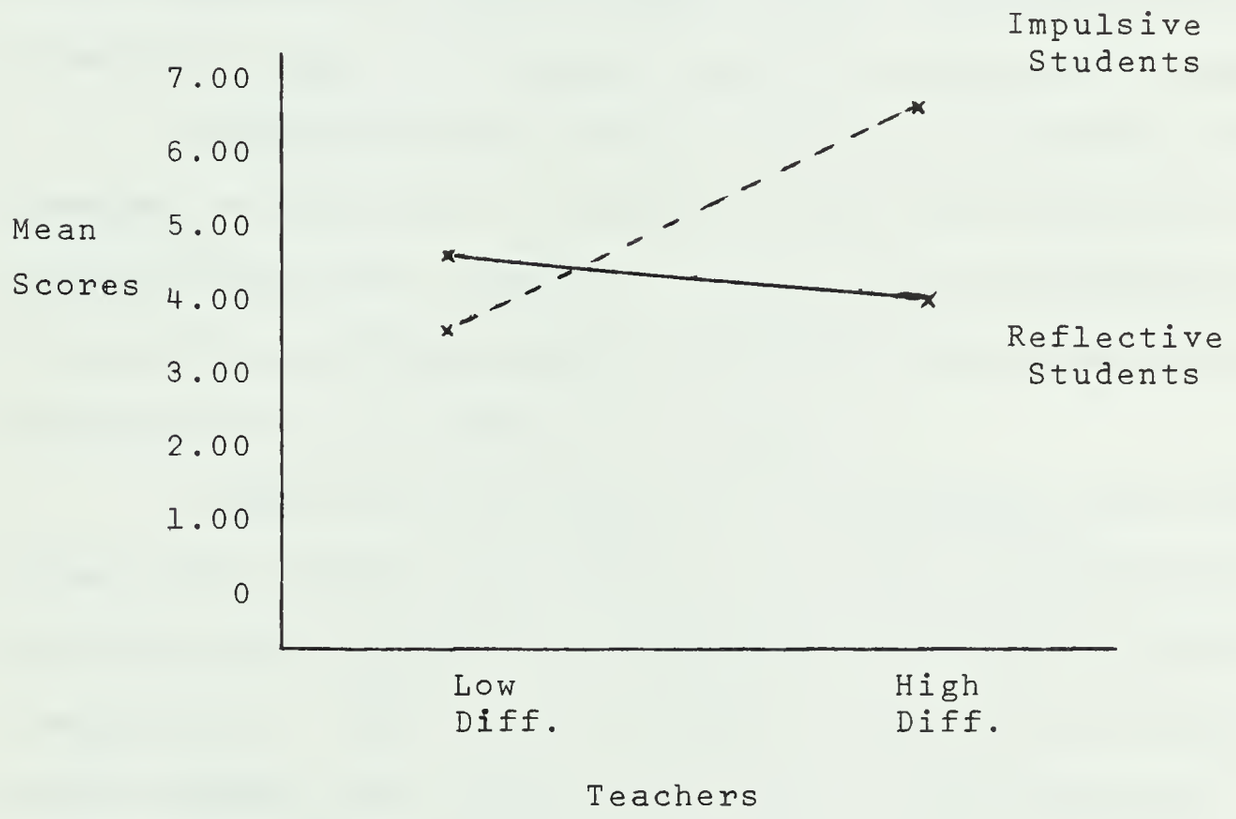
TABLE VII

MEAN SCORES OF STUDENTS WHEN CLASSIFIED ON BASIS OF TEACHER DIFFERENTIATION AND STUDENT REFLECTION - IMPULSIVITY

Teachers	Students	
	Reflective	Impulsive
High Diff.	3.9	6.5
Low Diff.	4.5	3.7

FIGURE II

PLOT OF TEACHER DIFFERENTIATION AND STUDENT REFLECTION - IMPULSIVITY INTERACTION



who are thought to differentiate on many dimensions did better with low differentiating teachers.

On the basis of these findings one may conclude that the decision-making performance of reflective and impulsive students is significantly different if they are in the classrooms of high or low differentiating teachers.

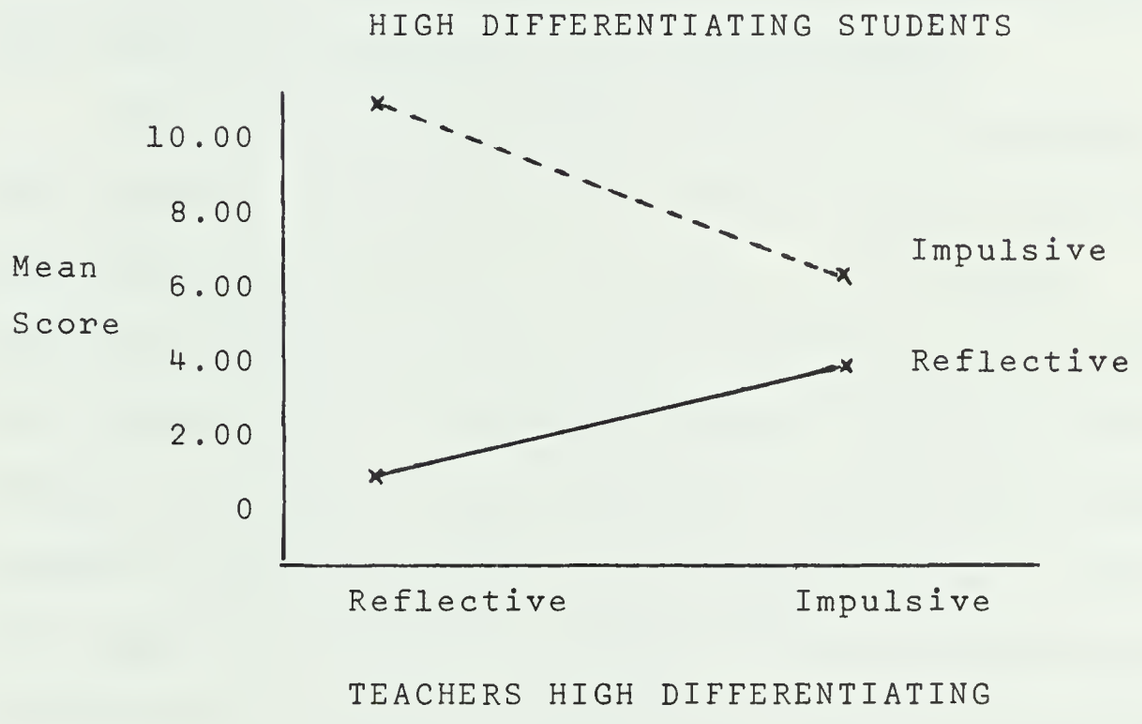
Analysis also revealed a significant ($p < .01$) interaction effect among both teacher styles (differentiation and reflection) and both student styles (differentiation and reflection). This is the ABCD interaction reported in Table V.

Decision-making scores of groups of students, categorized on the basis of differentiation and reflection who were situated with different teachers (also categorized on the basis of differentiation and reflection), were plotted and are shown in Figures III through VI.

Figure III illustrates the interaction that occurred when both teachers and students are high on differentiation and then are congruent or incongruent in terms of reflection-impulsivity. This type of analysis indicated that where both teachers and students are high on differentiation, the reflective students did better with impulsive teachers and the impulsive students did better with reflective teachers. In both cases, where there is incongruence between student and teacher information processing styles, decision-making performance appears to be better. This is similar to what Hunt (1971) suggested.

FIGURE III

PLOT OF REFLECTIVE-IMPULSIVE STUDENTS
WHEN STUDENTS AND TEACHERS MATCHED
ON HIGH DIFFERENTIATION



In the opposite situation (Figure IV) where both teachers and students were low on differentiation, there appeared to be little difference in the performance of reflective and impulsive students regardless of whether they are situated with reflective or impulsive teachers. Both reflective and impulsive students performed marginally better when situated with reflective teachers. This difference appears to be insignificant.

The two situations where students and teachers have opposite differentiation scores (Figure V and VI) illustrate disordinal interactions. In the first situation (Figure V) where high differentiating students are situated with low differentiating teachers, reflective students did better with reflective teachers and impulsive students performed better on the decision-making task, with impulsive teachers. In this case, the matching of teachers and students on reflection-impulsivity appears optimal. In the second situation (Figure VI) where low differentiating students were placed with high differentiating teachers, the reflective students performed better when they were situated with reflective teachers and impulsive students did better with impulsive teachers. As in the previous siutation, when teachers and students have opposite differentiation scores, the performance of students is better if teachers and students are matched on reflection-impulsivity.

FIGURE IV

PLOT OF REFLECTIVE-IMPULSIVE STUDENTS WHEN TEACHER AND STUDENTS MATCHED ON LOW DIFFERENTIATION

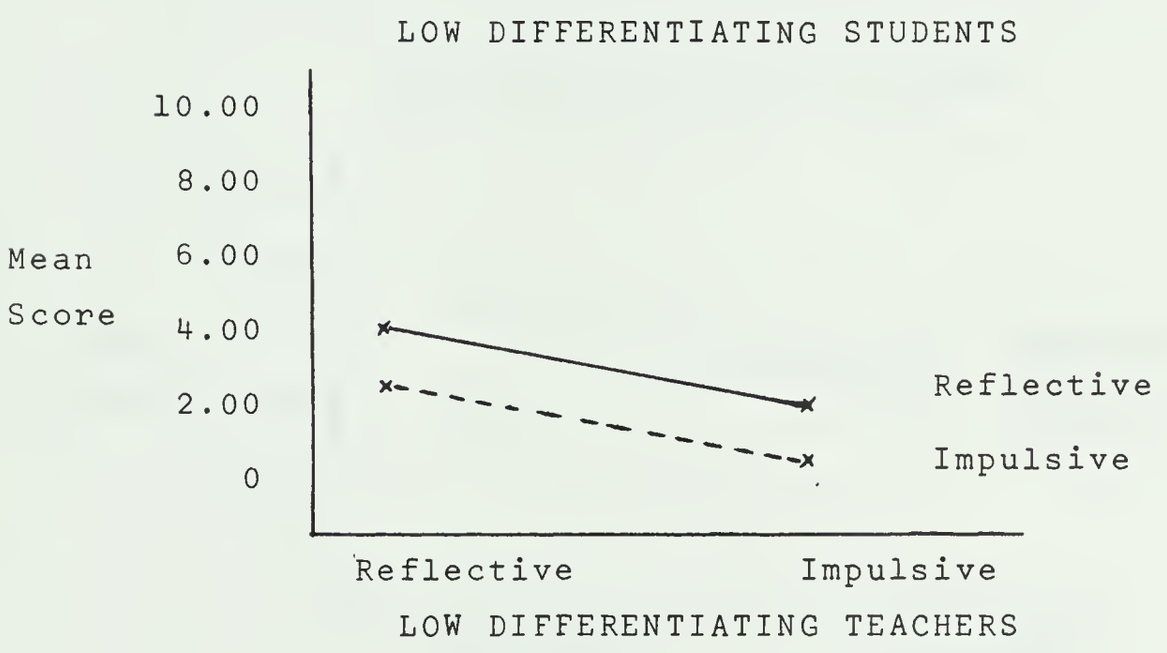


FIGURE V

PLOT OF REFLECTIVE-IMPULSIVE STUDENTS WHEN HIGH DIFFERENTIATING STUDENTS ARE MATCHED WITH LOW DIFFERENTIATING TEACHERS

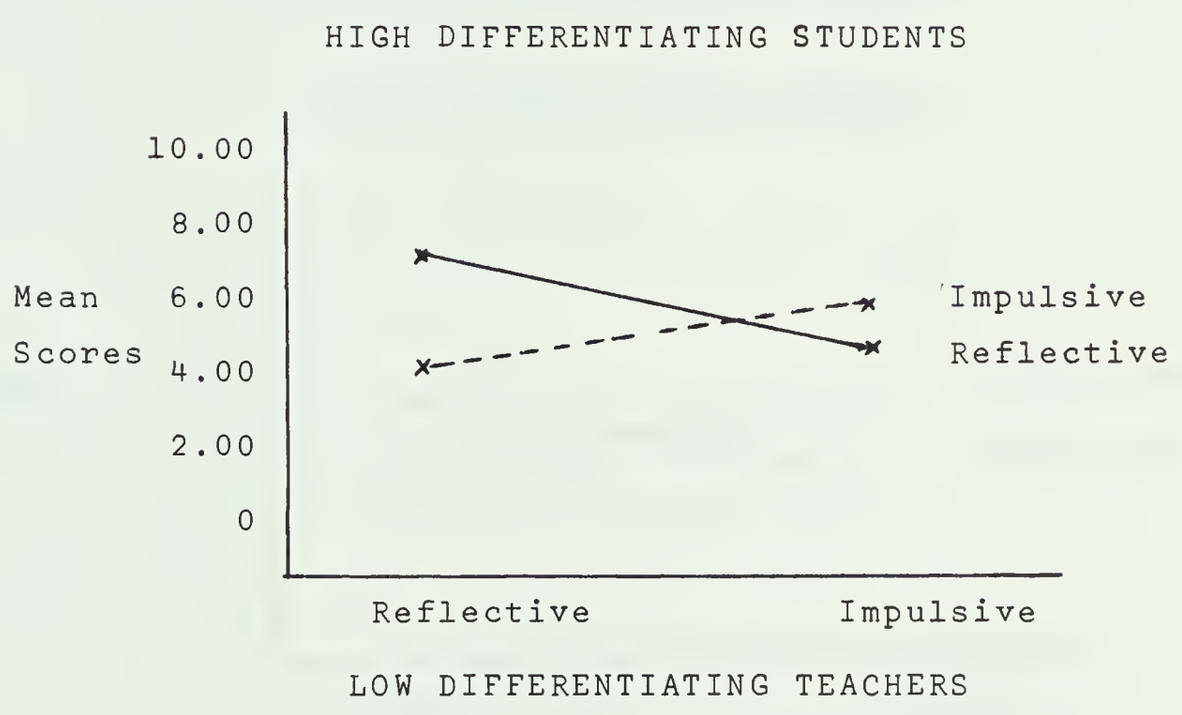
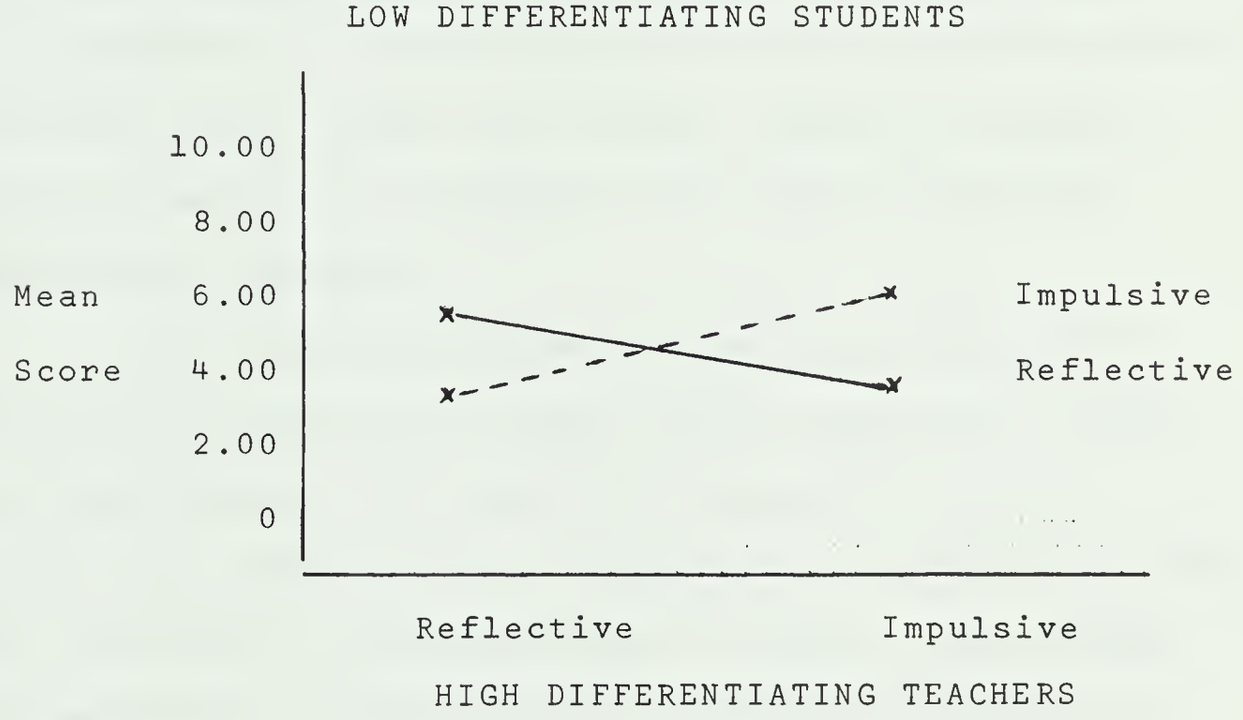


FIGURE VI

PLOT OF REFLECTIVE-IMPULSIVE STUDENTS
WHEN LOW DIFFERENTIATING STUDENTS ARE MATCHED WITH
HIGH DIFFERENTIATING TEACHERS



Discussion of Findings and Observations

The preceding analyses indicate that individual information processing styles significantly affected student performance on a decision-making task. This supports the theoretical bases for the study which suggest that individual differences on aptitudes, other than those closely related to general ability, should be accounted for when planning educational experiences.

The analyses also indicate that student performance is significantly affected when certain types of students (categorized by differentiation and reflection-impulsivity measures) are situated with certain types of teachers (also categorized by differentiation and reflection-impulsivity measures).

The findings partially support the reflection-impulsivity construct of Kagan and his associates (1964) by demonstrating that reflection-impulsivity has a significant effect if it is considered in combination with the construct of differentiation. However, the general pervasiveness and importance of reflection-impulsivity, which has been suggested by Kagan, is not supported by the findings since reflection-impulsivity does not appear to affect student performance on a decision-making task except when it interacts with differentiation.

Hypotheses and Summary of Findings

The following hypotheses were tested in this study.

Hypothesis I. There will be a significant difference in the decision-making performance of students who are categorized on the basis of their information processing styles.

The analysis indicated that a significant difference in student performance scores was attributable to individual differences on the information processing style of differentiation. Therefore, the hypothesis is accepted.

Hypothesis II. There will be a significant difference in the decision-making performance of students who are exposed to different environments which are represented by teacher information processing style.

While no support was found for the above hypothesis when using analysis of variance to compare classroom groups, there does appear to be some support in terms of the correlation that exists between teacher reflection-impulsivity and student differentiation. However, since analysis of variance indicated no significant differences between classroom groups, the hypothesis is rejected.

Hypothesis III. There will be a significant student-teacher interaction effect on the decision-making performance of students when students and teachers are categorized on the

basis of differentiation and reflection-impulsivity.

The findings of the analysis indicate that there is a significant interaction effect among teacher and student styles of information processing which affects student performance on a decision-making task. Therefore, the hypothesis is accepted.

Summary

An analysis of variance design was used to analyze the data in the present study. In addition, correlations among all variables were determined.

The analyses indicated that there were significant differences in student performance on a decision-making task which were attributable to student differences in ability to differentiate. No significant differences in performance were found to be attributable to student reflection-impulsivity, teacher reflection-impulsivity or teacher differentiation in terms of main effects.

However, significant interaction effects were found. The first was an interaction between teacher differentiation and student reflection-impulsivity. In this case an interaction occurred with reflective students performing best with low differentiating teachers and impulsive students performing best with high differentiating teachers.

The second significant interaction effect was a

four-way interaction among both categories of teachers (differentiation and reflection-impulsivity dimensions) and both categories of students (classified on differentiation and reflection-impulsivity). The analyses indicated that when students who were high on differentiation were situated with teachers who were high on differentiation, then student decision-making scores were optimal if students and teachers were not congruent in terms of differentiation (high differentiating students with low differentiating teachers or low differentiating students with high differentiating teachers) then optimal performance resulted if students and teachers were matched on reflection-impulsivity. The final combination of low differentiating students with low differentiating teachers resulted in poor performance levels for both reflective and impulsive students.

A summary of the study plus a discussion of the implications and recommendations for further research, based on the findings reported in this chapter are found in Chapter V.

CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS

Summary

The Problem. An analysis was undertaken to determine the main and interactive effects of teacher and student information processing styles on the decision-making performance of students. Teachers and students were both categorized according to the information processing styles of differentiation and reflection-impulsivity.

Theoretical Framework for the Study. Teachers who attempt to provide for individual differences among pupils may choose to alter the instructional setting in order to meet the perceived needs of particular students. A common practice in schools has been to differentiate students on the basis of intelligence quotient, achievement scores and according to socio-economic background. However, in recent years, new sources of individual variation have been postulated and, in some cases, researched. One source which has received considerable attention is concerned with the ways in which individuals process information. These differences in information processing styles apparently are not congruent with the conventional categories of ability in widespread use.

One of the earliest styles of information processing to be identified has been labelled differentiation. Kelly (1955) initially suggested that individuals differ in terms of the number of dimensions that they use in differentiating incoming information.

Several other styles of processing information were identified in the decade following Kelly's published work. Descriptions of these styles incorporated the construct of differentiation as being basic to higher order processing. Harvey, Hunt and Schroder (1961) identified the style of cognitive complexity, Schroder, Driver and Streufert identified integrative complexity as an important style and Kagan and his colleagues (1964) postulated the style of reflection-impulsivity. The last of these (reflection-impulsivity) appears to involve differentiation, integration (relating of dimensions that are differentiated) and finally is also concerned with selection among alternatives.

Interest in the quality of teacher-learner interaction has developed in conjunction with investigation into various types of processing styles. Several models have been postulated about ways of combining teachers and learners in order to optimise student performance. Models by Mogar (1969), Snow (1966) and Hunt (1971) are representative.

Purpose of the Study. The increasing interest in teacher-learner interaction as well as investigations into various types of information processing styles, has formed the basis for the present study. The purpose of the study was to investigate the effect of interaction among teacher and student information processing styles (differentiation and reflection-impulsivity) on student decision-making performance.

Hypotheses. It was hypothesized for the present study that (1) There will be a significant difference in the decision-making performance of students who are categorized on the basis of their information processing styles; (2) There will be a significant difference in the decision-making performance of students who are exposed to different environments which are represented by teacher information-processing styles; (3) There will be a significant student-teacher interaction effect on the decision-making performance of students when students and teachers are categorized on the basis of differentiation and reflection-impulsivity.

Assumptions. It was assumed for purposes of this study, that the teacher is a major determinant of the type of environment created in the classroom. In addition, it was assumed that the information processing style of the teacher significantly affects the manner in which a

teacher operates in the classroom and thus may be directly related to the environment for pupil learning which is created by the teacher.

Research Methods and Procedures. Teachers in the Edmonton Separate School System were asked to participate in the study if they met these criteria: were holders of a Bachelor's Degree; had a minimum of three year's teaching experience; were currently teaching grade six Social Studies.

Twenty-eight teachers in the school system met these criteria and twenty-six of these agreed to be tested by the researcher. Teachers were administered two instruments, the Adult Differentiation Test and Kagan's Matching Familiar Figures Test. Teachers were categorized on the basis of their scores on both tests. The teachers were then grouped into the following categories: High Differentiation-Reflective; High Differentiation-Impulsive; Low Differentiation-Reflective; and Low Differentiation-Impulsive. The two teachers, who represented the extreme scores in each category, were then chosen to participate. Thus, a total of eight teachers were involved in the study.

Students in the classes of the eight selected teachers were administered the Children's Differentiation Test and Kagan's Matching Familiar Figures Test. Students were categorized on the same basis as teachers. Teachers taught

their own students a unit in Social Studies over a period of six weeks. The unit was primarily concerned with the way in which social scientists operate. Emphasis is placed on factual description, inferences and value judgements. Upon completion of the unit, students were administered a criterion task on decision-making. An analysis of variance design was used to analyze the data for main and interaction effects.

Findings

Correlation. A correlation matrix of all the variables in the study revealed that there was no significant relationship between reflection-impulsivity scores and differentiation scores obtained by teachers or students. A significant correlation was found between student decision-making scores and both student and teacher differentiation scores. Intelligence quotient had a significant relationship to student differentiation scores. A negative correlation was found between teacher reflection-impulsivity and student differentiation scores. Finally, student reflection-impulsivity was found to be significantly correlated with sex of students.

Analysis of Variance. Analyses of variance revealed that the information processing style of the teacher, defined in terms of differentiation and reflection-impulsivity, had no direct main effect on student decision-making

performance. In the case of student information processing style, it was found that reflection-impulsivity had no significant main effect on student performance, but that differentiation did significantly (p .01) affect the decision-making performance of students. In addition, analysis of variance revealed no significant differences in decision-making performance among the eight classroom groups of students.

Two significant interaction effects were revealed by analysis of variance. In the first case it was found that when teacher differentiation and student reflection-impulsivity were combined, there was a significant effect on student decision-making performance. When reflective students were taught by a high differentiating teacher their decision-making performance scores were lower. On the other hand, when impulsive students were taught by a high differentiating teacher their decision-making performance scores were higher.

The second significant interaction effect involved both teacher and student information processing styles. It was found that when both students and teachers are high on differentiation, student decision-making performance is optimal if students and teachers are not both reflective or impulsive.

In the opposite situation where both teachers and

students are low on differentiation, there appears to be little difference in the performance of reflective and impulsive students when they are taught by reflective and impulsive teachers. In all combinations student decision-making performance is extremely poor when both teachers and pupils have low differentiation scores.

Where students and teachers were not matched on differentiation it was found that the decision-making performance scores of students were higher if reflective students are placed with reflective teachers, or if impulsive students are placed with impulsive teachers. This was the case when high differentiating students were situated with low differentiating teachers and also when low differentiating students were taught by high differentiating teachers. In other words, when teachers and students have opposite styles of differentiation, the performance of students is better if teachers and students are matched on reflection-impulsivity.

Implications

The present study has implications for both practitioners and theorists. These implications will be discussed as they relate to the areas of: 1) Individual differences; 2) Information processing theories; 3) Teacher selection and 4) Team teaching.

Individual Differences. This study developed two in-

struments (Children's Differentiation Test and Adult Differentiation Test) which could be used to identify differences among students and teachers in differentiating ability for purposes of teacher selection and pupil placement.

This study has indicated that the information processing style of differentiation (as measured by the instruments developed by the researcher) is a viable and significant variable to consider when assessing student aptitude and when assigning students to teachers. On the other hand, the findings raise some questions about the effect of the information processing style of reflection-impulsivity. Although previous research has indicated that the style of reflection-impulsivity is pervasive across many types of tasks (including tasks similar in context to the one used in this study), the findings in the present study suggest that reflection-impulsivity is not independent, but is significantly affected by another style of information processing (namely differentiation). This finding suggests that reflection-impulsivity does not operate as a main effect, but interacts with other information processing styles to produce significant effects on student performance.

Information Processing Theories. The fact that no correlation was discovered between differentiation (as defined in this study) and reflection-impulsivity (in terms of

teachers or students) raises certain questions about the information processing theories which suggest that differentiation has a significant influence on higher order information processing styles. Biggs (1972) has suggested that differentiation occurs in the stage before fine-coarse matching which he considers as being essentially the same as reflection-impulsivity. If this were the case, then the differentiating ability of the student would be expected to have an effect on his reflection-impulsivity score. The fact that this is not the case, suggests an area for further research. It is possible that the relationship between these two styles is hidden due to the fact that the measuring instruments have different contexts.

The significant effect of differentiation on student decision-making performance suggests that this style of information processing in particular should be investigated further. The fact that the style of differentiation significantly affected decision-making performance of students suggests that this might be one source of individual differences which should be considered when assessing students. Further research should be undertaken to determine the effect of differentiation on various types of tasks.

The most significant finding in this study was the overall interaction among teacher and student information processing styles which significantly affected student decision-making performance. The findings show that

optimal student performance results when students and teachers are matched on one style of information processing and not matched on another style. This supports Hunt's (1971) model. The findings suggest that optimal decision-making performance results when Mogar's (1969) congruency model is applied to one style of information processing and the compensatory model is applied to another style. The same is true of Snow's (1969) preferential and compensatory models. In other words, optimal decision-making performance results when students are situated with teachers who have one style of information processing that is similar to the students and one style that is dissimilar. Although this would be somewhat complex to implement, it would be possible providing that studies such as the present one were conducted to indicate which teacher-learner combinations were optimal.

The study also has implications for those responsible for the assignment of students to teachers. The analysis indicates that one definite combination to be avoided is the placement of low differentiating students with low differentiating teachers (regardless of reflection-impulsivity scores).

Teacher Selection. The results of the study also have implications for selection of candidates for teacher training. If low differentiating teachers were not

selected, then the problem of student placement would be greatly simplified. At the present time the process of selecting teacher candidates is relatively primitive as it is based primarily on academic achievement. In the future it may be possible to have a wide range of instruments which will measure those aspects thought to contribute to the quality of teaching.

Team Teaching. The fact that there appear to be certain combinations of teachers and students which result in optimal performance suggests that if it is not administratively feasible to arrange all students and teachers in optimal combinations, then any detrimental effects, which might occur due to teachers who do not have the most favourable information processing styles, might be minimized by team teaching. Although the hypothesis regarding main effects due to teacher information processing styles was rejected, the analysis indicated that there definitely is a teacher interaction effect. In other words, certain types of students perform at a lower level (in terms of decision-making) when they are in the classrooms of teachers who have certain types of information processing styles. Therefore, it would likely be better for those students to be exposed to a number of teachers rather than to only one teacher who has a style of information processing which interacts with that student's information process-

ing style in such a way as to lower performance.

Recommendations for Further Research

On the basis of the findings in this study it is recommended that further research be undertaken on the interaction of differentiation, reflection-impulsivity and other information processing styles in terms of their effect on student performance in a variety of tasks. In addition, it is recommended that research be undertaken to attempt to determine if the information processing style of the teacher does influence the environment created in the classroom. Interaction analysis in the classrooms of teachers with different information processing styles might illuminate a new area of exploration for research.

In the present study one thirty-minute tape recording was taken of each teacher. The transcripts of these tapes indicate that this may be an important area for exploration. However, the tapes that were recorded during the present study are not adequate to permit detailed analysis and were not considered to be part of the study.

Recommendations for Practical Application

The results of the study indicate some areas where practical application could occur. A few schools in any

school system could test their students and teachers, on the basis of the instruments developed in this study, and group students and teachers on the basis suggested by the present research.

A second area of application would be to test all applicants for teacher education programs and determine if success of candidates is related to their information processing style. Although this would actually be a longitudinal research project, it would be a first step in developing a more realistic selection procedure.

Concluding Statement

The analyses undertaken in this study have revealed a complex interaction among teacher and student information processing styles which should form an important base for further research as well as provide an elementary guideline for assigning students to selected teachers.

REFERENCES

REFERENCES

Bieri, J. Cognitive complexity-simplicity and predictive behaviour. *Journal of Abnormal and Social Psychology,* 1955, 51, 263-68.

Bieri, J. Cognitive complexity and personality development. In O.J. Harvey (Ed.), *Experience structure and adaptability.* New York: Springer, 1966, 13-37.

Biggs, J.B. *Information and human learning.* Melbourne: Cassell, 1968.

Biggs, J.B. Coding and cognitive behaviour. *British Journal of Psychology,* 1969, 60(3), 287-305.

Biggs, J.B. Personal communication. 1970.

Biggs, J.B. Learning, teaching, and cognitive growth. In preparation, 1972.

Bloom, Benjamin S. Learning for mastery. *Evaluation Comment,* 1968, 2 (May).

Carroll, John B. A model of school learning. *Teachers College Record,* 1963, 64, 323-333.

Cronbach, T.J. How can instruction be adapted to individual differences. In R.M. Gagne (Ed.), *Learning and individual differences,* New York: Macmillan, 1967, 23-44.

Cronbach, L.J. Test validation. In R.L. Thorndike (Ed.), *Educational measurement.* Washington: American Council on Education, 1971, 443-507.

Driver, M.J. Conceptual structure and group processes in an Inter-Nation Simulation. Part one: The perception of simulated nations. Research Bulletin No. 62-15, 1962, Educational Testing Service.

Fox, Robert S. The sources of curriculum development. *Theory Into Practice,* 1962, 1 (Oct.) 204.

Fry, Edward. A Readability Formula that saves time. *Journal of Reading,* 1968, 11, 513-577.

Gordon, Ira J. (Ed.) *Theories of Instruction.* Washington: Association for Supervision and Curriculum Development, 1968.

Gupta, Prem. Correlates of reflection-impulsivity. Unpublished doctoral dissertation, University of Alberta, 1970.

Harvey, O.J. Hunt, D.E. and Schroder, H.M. *Conceptual systems and personality organization.* New York: John Wiley and Sons, Inc. 1961.

Hess, R.D. and Shipman, V. Early experience and the socialization of cognitive modes in children. *Child Development,* 1966, 37, 870-886.

Hunt, David E. A conceptual level matching model for co-ordinating learner characteristics with educational approaches. Paper presented at the American Educational Research Association annual meeting, Minneapolis, March 1970.

Hunt, David. E. *Matching models in education,* Toronto: Ontario Institute for Studies in Education, Monograph Series No. 10, 1971.

Hunt, David E. and Joyce, B.R. Teacher trainee personality and initial teaching style. *American Educational Research Journal,* 1967, 4 (May), 253-259.

Johnson, Mauritz. The translation of curriculum into instruction. *Journal of Curriculum Studies,* 1969, 1 (No. 2), 115-131.

Kagan, Jerome. Reflection-impulsivity and reading ability in primary grade children. *Child Development,* 1965, 36, 609-628.

Kagan, Jerome. Reflection-impulsivity: The generality and dynamics of conceptual tempo. *Journal of Abnormal Psychology,* 1966, 77, 17-24.

Kagan, Jerome, Pearson L. and Welch. L. Conceptual impulsivity and inductive reasoning. *Child Development,* 1966, 37, 583-594.

Kagan, Jerome, Pearson L. and Welch, L., The modifiability of an impulsive tempo. *Journal of Educational Psychology,* 1966, 57, 359-365.

Kagan, Jerome, Rosman, B.L., Day, D., Albert, J., and Phillips, W., Information processing in the child: Significance of analytic and reflective attitudes. *Psychological Monographs,* 1964, 78 (Whole No. 578).

Kogan, Nathan. Educational implications of cognitive styles. In Gerald S. Lesser (Ed.), *Psychology and Educational Practice*. Glenview, Illinois: Scott, Foresman and Co. 1967.

Kelly, George A. *The Psychology of personal constructs*. New York: W.W. Norton and Company, 1955.

Lippitt, R., Fox, R., and Schaible, L. *Social Science Laboratory Units*. Chicago: Science Research Associates, Inc., 1969.

McLachlan, J.F.C. Individual differences and teaching methods in student interpretation of modern art. Unpublished master's thesis, University of Toronto, 1969.

Messick, Samuel. *The criterion problem in the evaluation of instruction: assessing possible not just intended outcomes*. Princeton: Educational Testing Service, 1968.

Mogar, R.E. Toward a psychological theory of education. *Journal of Humanistic Psychology,* 1969, 9, 17-52.

Murphy, Patricia D. Conceptual systems and teaching styles. Paper presented at the American Educational Research Association Annual Meeting, Minneapolis, March, 1970.

Piaget, Jean. *The origins of intelligence in children*. Margaret Cook (Translator). New York: Basic Books, Inc. 1954.

Pohl, R.L. and Pervin, L.A. Academic performance as a function of task requirements and cognitive style. *Psychological Reports,* 1967, 22, 1017-1020.

Reitman, W.R. Cognition and thought: *An information-processing approach*. New York: John Wiley and Sons, 1965.

Roy, S.N., and R.C. Base, Simultaneous confidence interval estimation. *Ann. Math. Stat.,* 1953, 24, 513-536.

Saylor, J.G. and W.M. Alexander. *Curriculum planning for modern schools*. New York: Holt, Rinehart and Winston Inc. 1966.

Schroder, Harold M. Driver, M.J., and Streufert, S. *Human information processing*. New York: Holt, Rinehart and Winston, Inc. 1967.

Sieber, Joan E. and Lanzetta, J.T. Conflict and conceptual structure as determinants of decision-making behaviour. *Journal of Personality,* 1964, 32 (4), 622-641.

Snow, R.E. Research on media and attitudes. Paper given at conference on research on instructional media and attitudes. Indiana University, Bloomington, Indiana, June 1969. Referred to in Hunt, D.E. *Matching models in education.* Toronto: Ontario Institute for Studies in Education, Monograph Series No. 10, 1971.

Stake, R.E. The countenance of educational evaluation. *Teachers College Record,* 1967, 68, 523-540.

Streufert, S., Clardy, M., Driver, M.J., Karlins, M., Schroder, H.M., and Suedfeld, P. A tactical game for the analysis of complex decision-making in individuals and groups. *Psychological Reports,* 1965, 17, 723-729.

Streufert, S., and Schroder, H.M. Conceptual structure, environmental complexity and task performance. *Journal of Experimental Research on Personality,* 1965, 1, 132-137.

Tomlinson, P.D. Differential effectiveness of three teaching strategies for students of varying conceptual levels. Unpublished master's thesis, University of Toronto, 1969.

Tomlinson, P.D. and Hunt, David E. The differential effectiveness of three teaching strategies for students of high and low conceptual levels. Paper presented at the American Educational Research Association annual meeting, Minneapolis, March, 1970.

Tuckman, B.W. Personality, structure, group comparison and group functioning, *Sociometry,* 1964, 27, 469-487.

Tuckman, B.W. A study of the effectiveness of directive vs. non-directive vocational teachers as a function of student characteristics and course format. USEO final report, 1968.

Wallach, M.A. Commentary: Active-analytical vs. passive-global cognitive functioning. In S. Messick and J. Ross (Eds.), *Measurement in Personality and Cognition* New York: John Wiley and Sons, 1962.

Ward, W.C. Reflection-impulsivity in kindergarten children. *Child-Development,* 1968, 39, 867-874.

Yando, R.M. and Kagan, Jerome. The effect of teacher tempo on the child. *Child Development,* 1968, 39, 27-34.

APPENDIX A

CHILDREN'S DIFFERENTIATION TEST

CHILDREN'S DIFFERENTIATION TEST

Below are two stories about two girls who live on different planets. Read the stories and then write down how these girls are different and how the way they live is different.

Ziga of the planet Kres is a most interesting person. She is the youngest in the family. Her mind is more advanced than a computer. This comes from the Kresian's large thirst for knowledge. At school, the children memorize sets of encyclopedias and then re-write them.

Ziga has light brown hair and blue eyes. She wears a shiny metallic suit of the best quality. The metal in the suit deflects any harmful rays from exploding stars or from the sun. The suit maintains a constant temperature inside. This is important since the temperature varies from 100° below zero at night to 200° above during the day. Kres has no atmosphere and oxygen must be brought in from other planets.

Ziga pilots a mini-plane that runs on helium. Ziga's parents own a beautiful house. Food is served in pill form by a computer in the kitchen. In the bathroom the shower projects rays through Ziga's clothes and this leaves her clean. There are many synthetic plants on the planet of Kres and these make it beautiful.

Ziga and her parents and brothers and sisters have many good times together and go on many trips between planets. Ziga enjoys all the activities and also the rapid new developments which take place every day on her planet.

* * * *

Asta of the planet Goz is similar to every other person on the planet. This is the result of an interplanetary war which has forced the Gozians to live underground in great apartment complexes. Great machines in the centre of these complexes control the lighting and heating systems, the food preparation and the interplanetary television system.

Asta's room is the same as all the other apartments. The apartment is bare with no pictures, plants or furniture. During the day, her bed folds into the wall and all that she is able to look at is the TV. This is her only form of entertainment. Meals are served by the great machine. Asta simply presses a button and her meals are served. All meals

consist of vegetables. The Gozians never eat meat and are not advanced enough to prepare meals in pill form.

Asta is very lazy. She does not go to school or study. She will never have to work since the Great Machine does everything. If she wants to know anything she simply turns on the TV.

Asta wears a red nylon pant suit. The colour of her suit tells other people what section of the apartment she comes from. To travel within the apartment complex Asta uses an electric chair. Asta has never travelled outside of the apartment. She has never seen grass, flowers, the sun, stars or the sky.

Asta's parents live in the apartment next to hers. However, she seldom sees her parents and never goes anywhere with them. Asta likes her lazy life and does not miss anything since she has never done anything different.

(OVER)

WRITE ANSWERS BELOW

APPENDIX B

SCORING KEY FOR CHILDREN'S DIFFERENTIATION TEST

POSSIBLE COMPARISONS IN CHILDREN'S DIFFERENTIATION TEST

COMPARISON I	- INTELLIGENCE -	Ziga highly intelligent Asta is not
COMPARISON II	- EDUCATION -	Ziga - school - encyclopedia Asta - no school
COMPARISON III	- CLOTHES -	Ziga - metallic Asta - nylon
COMPARISON IV	- ENVIRONMENT -	Ziga - No O_2 - great temperature difference Asta - Artificial - controlled
COMPARISON V	- TRANSPORTATION -	Ziga - Mini-plane Asta - electric chair
COMPARISON VI	- FOOD -	Ziga - pills Asta - vegetables
COMPARISON VII	- TRAVEL -	Ziga - travels considerably Asta - never travels
COMPARISON VIII	- FAMILIAL RELATIONS -	Ziga - close Asta - distant
COMPARISON IX	- HOUSING -	Ziga - house Asta - apartment
COMPARISON X	- ACTIVITY -	Ziga - active Asta - lazy
COMPARISON XI	- PURPOSE OR FUNCTIONS OF CLOTHES -	Kres versus Goz
COMPARISON XII	- LIVING ON SURFACE VS.	UNDERGROUND
COMPARISON XIII	- ENTERTAINMENT VS. ACTIVITIES T.V.	
COMPARISON XIV	- PEACEFUL PLANET VS. WARRING	
COMPARISON XV	- INDIVIDUAL DIFFERENCES IN INHABITANTS KRES VS. GOZ	

APPENDIX C

ADULT DIFFERENTIATION TEST

ADULT DIFFERENTIATION TEST

Below are two descriptions of boys. Read the two excerpts and then state how the two children differ. Write your comparison on the attached sheet.

Initially, John walked around cautiously watching the other children, worked quietly along with a puzzle, or looked at a book. He looked serious and tense, but every once in a while, when he passed a friend or an adult, he would smile. John did what the teacher requested if she talked directly to him. He kept busy with his own ideas which were abundant and often quite original. He was very friendly to adults, but rarely asked for help. Outdoors, John was graceful in his movements running around freely, joining climbing games in the jungle gym, and going as high and jumping as far as anyone. John was an unaggressive member of the group. He did not pick fights and approached peers in a tentative manner. He rarely objected if another child took something with which he was playing. John very rarely gave up on a task until it was completed. One day he spent a long time sawing wood. Another day he spent at least half an hour making something out of tinker toys. John was skilled and persistent at working hard puzzles. Even when there was much noise and confusion in the room, he continued to work very hard at what he was doing. When a lot of wild activity or rough play started, he would withdraw.

* * * * * * * * *

Chris was very active but also stood out as more babyish than the other children. He flitted from one activity to another and had the shortest attention span of the entire group. At times he was unusually impulsive, breaking other people's houses, chasing around the hall, running into bikes on the playground, and falling over things because he didn't notice them. Chris was physically and verbally aggressive. He would steal a ball from another child or annoy children who were playing in a group. He liked to kick objects around and tease the girls. However, he became angry when someone took something from him or when he felt he was not being listened to. He always ignored the teacher's direction to help in the clean-up, even when told directly. It seemed very important that he be playing with somebody, and he was constantly going to adults for attention and approval, showing them what he had brought home or talking to them about something that had happened. Chris rarely stuck with an activity for any amount of time. He would try a puzzle for a minute and then race off. He preferred simple

toys such as pegboards. He never sat down and really worked on any puzzle. Occasionally he would dash off a picture, splattering the paint and then leaving it. Chris was facile in his use of language. He talked all of the time, chattering away about all sorts of things, the way he felt, what he had done at home, what he was going to do next.

(OVER)

WRITE ANSWER BELOW

APPENDIX D

SCORING KEY FOR ADULT DIFFERENTIATION TEST

COMPARISONS POSSIBLE IN ADULT DIFFERENTIATION TEST

I.	Peer Relationships	1. John - apprehensive of others tentative moves to peers Chris - sought out peer relationships
		2. John - prefers to work on own Chris - prefers group activities
		3. John - considerate of others Chris - not considerate
		4. John - not competitive Chris - competitive
II.	Attention Span	5. John - long Chris - short
		6. John - patient Chris - impatient
		7. John - persistent Chris - not persistent
		8. John - methodical approach Chris - random approach
III.	Adult Relationships	9. John - rarely seeks approval Chris - constantly seeking approval
		10. John - independent Chris - dependent
		11. John - secure Chris - insecure
IV.	Motor Development	12. John - well developed motor ability Chris - not well developed
		13. John - graceful, free Chris - clumsy
V.	Verbal Activity	14. John - quiet Chris - always talking
VI.	Maturity	15. John - mature Chris - immature
		16. John - more advanced development Chris - not advanced
		17. John - stable Chris - neurotic

VII.	Obedience	18. John - yes Chris - no
		19. John - responsible Chris - irresponsible
VIII.	Toy Preferences	20. John - complex puzzles Chris - simple peg board
IX.	Anger	21. John - shows little anger Chris - gets angry
		22. John - non-violent Chris - violent
		23. John - not aggressive Chris - aggressive
X.	Passivity-Activity	24. John - passive physically Chris - active physically
		25. John - shy, withdrawn Chris - not shy
		26. John - more active mentally Chris - not so active mentally
XI.	Thought Patterns	27. John - convergent Chris - divergent
		28. John - reflective Chris - impulsive
		29. John - conformist Chris - non-conformist
XII.	Task Orientation	30. John - ability to complete tasks Chris - not likely to complete tasks
		31. John - pride in work Chris - no
		32. John - studious Chris - not
		33. John - conscientious Chris - not
		34. John - intrinsically motivated Chris - extrinsically motivated

APPENDIX E

DECISION MAKING TEST

DECISION MAKING TEST

Below is a story about a boy. In the story the boy has a problem. There are several ways in which the boy might solve the problem. These are listed after the story. You are to read the story and then select the best way of solving the problem and write down why you think this is the best. Next, pick the second best way. Then the third best way and so on until you have done all six ways.

STORY

Every day, right after school, Herb felt himself grow nervous and tense. He would run outside to the playground and jump on his bike. Then he would begin riding home with the other kids.

Now and then, Herb didn't pedal fast enough and fell behind. That's when the other kids would turn around and tease him because he couldn't keep up with them.

Twice he tipped over at the bottom of Washington Hill when he tried to make a turn. This was very embarrassing. That was bad enough but what made it worse was that it hurt when he fell.

Herb had figured that he'd really be in with the other kids when he got his own bike to ride to school. Instead, they just made fun of him. He was miserable.

"What's the matter with me? What am I doing wrong?" he asked himself over and over again. Maybe I could leave school earlier in the afternoon? Then I wouldn't have to run into those guys. But no, he quickly realized, that wouldn't work because he knew that he couldn't get out of school early.

Why don't I just walk then, he wondered. No, that's stupid. I want to ride my bike. Besides, it's too far to walk. What in the world am I going to do? Maybe I should just pedal faster.... Just the thought of pedaling faster made his stomach feel funny and his mouth go dry. He could just see himself on that hill...going faster and faster down, down...faster...faster...CRASH! There he was, flat on the ground, hurt and crying with his bike on top of him. He could even see the other kids and hear them laughing. At that moment, he realized what his problem really was.

"I know what's the matter with me," he said aloud. "I'm afraid of that hill!"

TURN TO THE NEXT PAGE

(2)

Listed below are six different ways that Herb could have solved his problem. Which is the best decision and why? Which is the second best and so on?

Write the number 1 beside the decision that is best. Write the number 2 beside the second best. Number the rest from 3 to 6.

Number

6 A Herb decided to ask his parents to move to another part of the town where nobody knew him and where he could start all over with a new group of kids.

This solution would be good or bad for Herb because

_____

_____

_____

1 B Herb realized that he was afraid of the hill and decided to practice on another hill where no one would see him until he got over being afraid.

This solution would be good or bad for Herb because

_____

_____

_____

4 C Herb realized that he was really afraid of the hill and decided to ride home from school along a different route without a hill, even though none of the kids went that way.

This solution would be good or bad for Herb because

(3)

_____

_____

_____

__5__ D Herb decided to stop riding his bicycle to school and to tell the other kids that it had been stolen.

This solution would be good or bad for Herb because

_____

_____

_____

__2__ E Herb decided that if he kept riding down the hill with the other kids they might get used to seeing him tip over and they'd stop teasing him.

This solution would be good or bad for Herb because

_____

_____

_____

__3__ F Herb decided to tell the other kids that he was afraid of the hill and ask them to help him get over it.

This solution was good or bad for Herb because

_____

_____

APPENDIX F

MATCHING FAMILIAR FIGURES TEST